Aviation Week and Space Technology

October 30, 1961

Welsh Analyzes U. S. Space Expenditures

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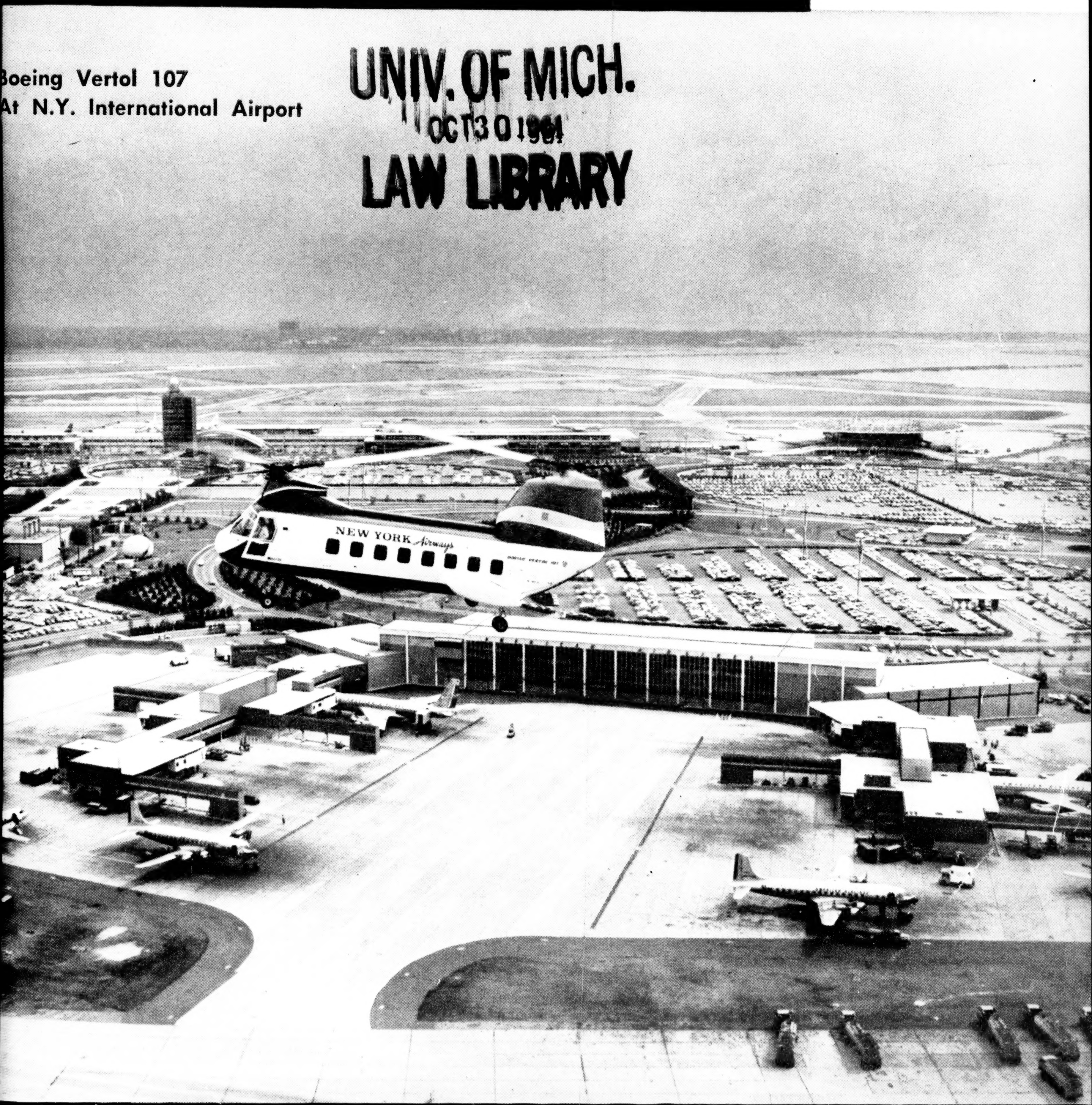

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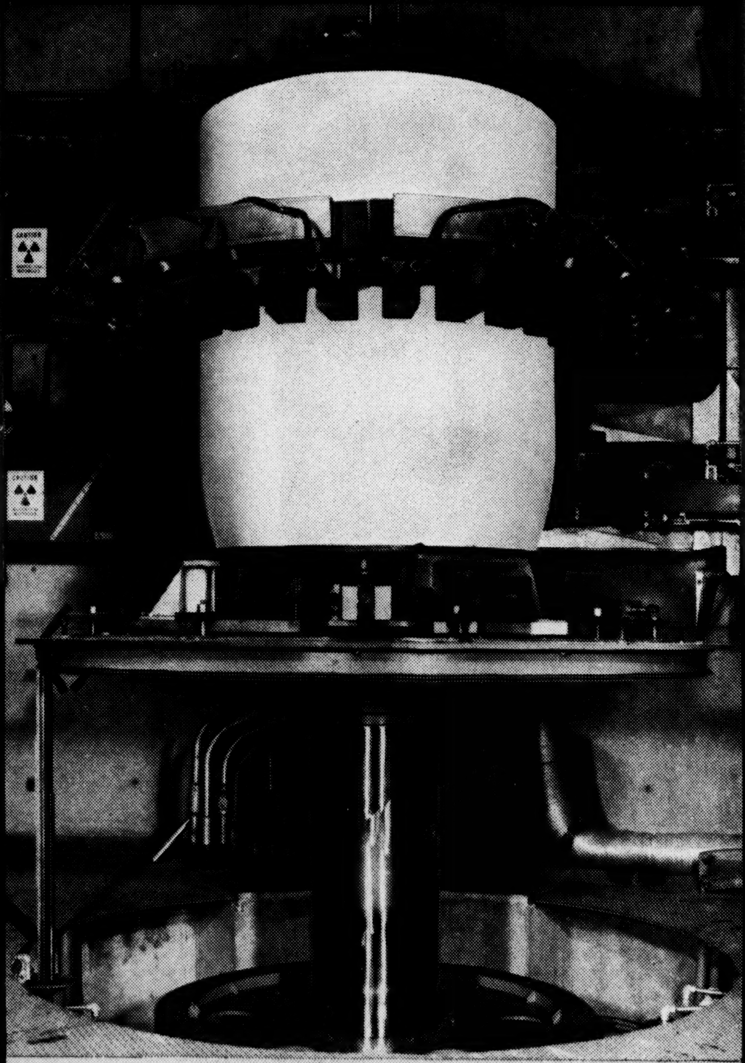

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Nov. 6-8—Special Technical Conference on Non-Linear Magnetics, IRE, Statler Hilton Hotel, Los Angeles, Calif.

Nov. 6-8—Annual Convention, American Documentation Institute, Somerset Hotel, Boston, Mass.

Nov. 6-8—Briefing Session: Military Preservation & Packaging, Ambassador Hotel, Los Angeles, Calif.

Nov. 6-9—1961 Conference and AtomFair, Atomic Industrial Forum and American Nuclear Society, Conrad Hilton Hotel, Chicago, Ill.

Nov. 7-9—Seventh Conference, Radio Interference Reduction and Electronic Compatibility, Armour Research Foundation, Illinois Institute of Technology, Chicago.

Nov. 8-11—62nd Meeting, Acoustical Society of America, Cincinnati, Ohio.

Nov. 9-10—Fifth Annual Display, Aerospace Electrical Society of San Diego, Balboa Park, San Diego, Calif.

Nov. 9-10—11th National Conference, Aircraft and Missiles Division, American Society for Quality Control, Ambassador Hotel, Los Angeles, Calif.

Nov. 13-14—Electrically Exploded Wire Conference, Kenmore Hotel, Boston, Mass. Sponsor: Thermal Radiation Laboratory, Geophysics Research Directorate, AF Cambridge Research Laboratories.

Nov. 13-16—Conference on Magnetism and Magnetic Materials, Institute of Radio Engineers, Hotel Westward Ho, Phoenix.

Nov. 14—Symposium on Electronic Systems Reliability, IRE, Kansas City, Mo.

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AVIATION WEEK and Space Technology

October 30, 1961

Vol. 75, No. 18

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

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AEROSPACE CALENDAR

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Nov. 14-16—Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Commonwealth Armory and Somerset Hotel, Boston, Mass.

Nov. 15-17—19th Annual Aerospace Electrical Society Display, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 19-22—Symposium on Biomedical Aspects of the Space Sciences, University of California at Los Angeles, Los Angeles, Calif. Sponsors: Brain Research Institute, UCLA; Air Force Office of Scientific Research.

Nov. 19-24—Medical and Biological Problems in Space Flight Conference, Nassau, Bahamas.

Nov. 27-Dec. 1—Army-Industry Aviation Logistics Symposium, Congress Hotel, St. Louis, Mo.

Nov. 28-30—38th Meeting, Aviation Distributors and Manufacturers Assn., Jung Hotel, New Orleans, La.

Nov. 30-Dec. 1—12th National Conference, Institute of Radio Engineers' Professional Group on Vehicular Communications, Radison Hotel, Minneapolis, Minn.

Dec. 4-5—Beryllium Metallurgy Conference, New York University's Washington Square Center, New York, N. Y.

Dec. 5—11th Annual Meeting, National Air Taxi Conference, Statler-Hilton Hotel, Washington, D. C.

Dec. 5-7—Annual Convention, National Aviation Trades Assn., Statler Hilton Hotel, Washington, D. C.

Dec. 12-14—Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.

Dec. 18—25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 30.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, U. S. Naval Postgraduate School, Monterey, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

October 30, 1961

Aviation Week and Space Technology

Vol. 75, No. 18
Member ABP and ABC

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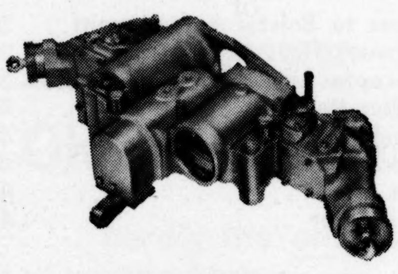
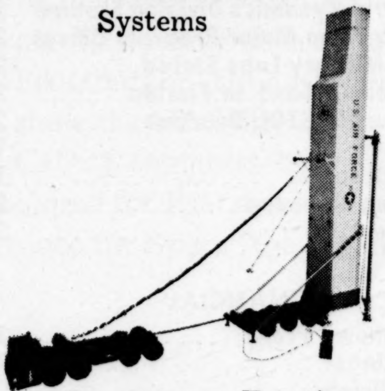


Missile Thrust Vector Control Systems



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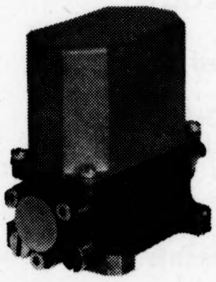

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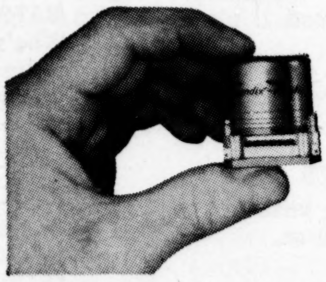

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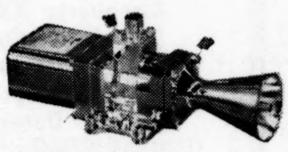
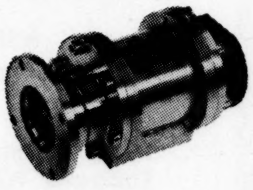


Attitude Thrust Controllers – Space Vehicle



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EDITORIAL

Strategy of Terror

It appears that the conflict over the status of West Berlin has now become a massive battle of will power in which the Soviet Union hopes to scare the Western powers into a humiliating withdrawal by a strategy of terror. It is apparently the Soviets' hope that by brandishing their nuclear power they can create the impression among Western nations that anything, including a Berlin withdrawal, would be preferable to full scale nuclear war. Nikita Khrushchev's advance announcement of Soviet intentions to detonate a 50-megaton bomb and his flat claim that the Soviets now possess a "gigaton" (100 megaton) bomb are clearly part of this strategy of terror aimed at impressing the rest of the world with the horrors the Soviets are capable of inflicting on those who oppose their will. Both the wide variety and the speed of the current Soviet nuclear weapons tests combined with the number of recent missile test shots into the Pacific indicate that the Soviets are engaged in a massive and accelerated effort to improve their nuclear weapons strength.

Although the ICBM defense claim of Marshal Rodion Malinovsky, Soviet defense chief, has been widely publicized in daily newspapers, there were many aspects of his speech indicating the size and scope of the accelerated Soviet defense program that were not. For this reason we are devoting a major portion of this space to a dispatch from Ernest Conine, McGraw-Hill World News correspondent in Moscow, covering these portions of Marshal Malinovsky's speech.

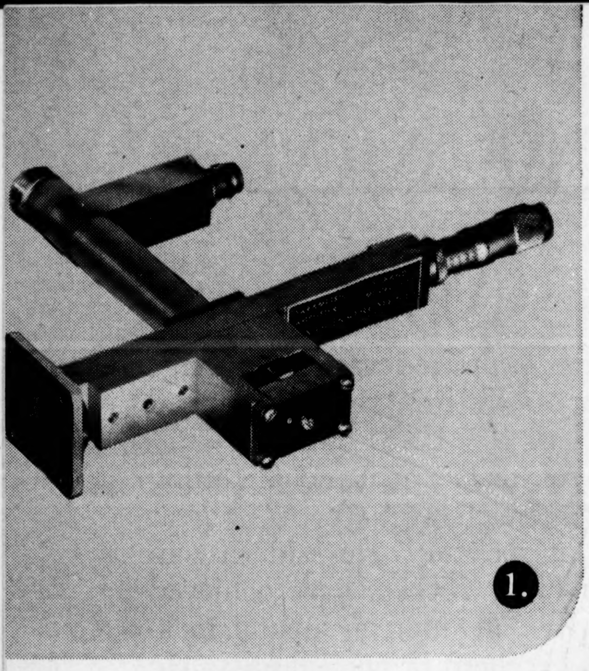
The main points made by the Defense Minister included:

- **In today's world** any armed conflict inevitably will become a total rocket nuclear war if it involves "attack on a nuclear power." The Soviet Union, Malinovsky said, admittedly would suffer grave injury in such a war but is less vulnerable than Capitalist countries because Russia is great and vast. "We are confident," he said, "that if Imperialists start a war with us the Socialist camp will win and Capitalism will be destroyed forever."
- **In light of the build-up** of U. S. military strength, the Soviet Union has been forced to suspend demobilization and to increase military spending. Concrete measures have been taken to bring the armed forces to combat readiness. Although claiming that Soviet conventional arms are stronger than ever, Malinovsky made clear that the emphasis is on nuclear weapons delivered by rockets. The Soviet defense chief also indicated that "wide introduction of nuclear arms" began long before the present Berlin crisis. A new kind of armed force has been created, Malinovsky said—strategic rocket nuclear troops which are in constant readiness. They are capable of inflicting a crushing defeat upon an aggressor. He warned that these forces already are equipped with weapons totaling many megatons capacity, so if necessary they can deliver more destructive force than was assumed in a study by the Joint Congressional Committee on Atomic Energy. He referred to conclusions that 263 thermonuclear weapons averaging five megatons each would kill up to 53 million people, devastate 71 large cities and 132 major military objectives, as well as spread radiation over more than half the U. S. territory.
- **"Volume of production** of rocket armaments during recent years has increased so much we have . . . a great surplus of different types of rockets." He said that in tests, 90% of the medium-range rockets have achieved excellent or good results while all intercontinental rockets launched have achieved excellent or good results. He said that rockets are more accurate over great distances than short ones. "Delegates to the Congress will be interested to know," he said, "that at present in our military rocket units are about 1,800 subdivisions. They . . . can shoot to any area of the globe without mistake."
- **Land army** is equipped with tactical nuclear rockets with ranges "from several to many hundreds of kilometers," and can be launched on short notice. He described land forces as highly maneuverable and capable of deep penetrations "in conditions of application of nuclear arms by the enemy."
- **Strong airdrop capability is shown,** said Malinovsky, by the fact that in maneuvers "our military transports alone have dropped over 100,000 paratroops" not counting transport of other personnel and freight. He pointed to the additional availability of airlift by the civil aviation fleet.
- **Special attention** has been given to anti-aircraft and anti-rocket defenses. Whereas in World War II an average of 400-600 shots were required to down an enemy plane, "one or two" anti-aircraft rockets now can down a plane flying at great speed and at altitudes twice as great as the range of conventional anti-aircraft guns, he said.

It was at this point that the Soviet defense chief said "the problem of destroying rockets or missiles in flight is successfully solved." He didn't elaborate. Malinovsky said there are about 1,200 subdivisions in the anti-aircraft forces.

- **Piston-engine planes** in the air force have been "completely replaced by up-to-date" jet aircraft including supersonic long-range bombers. Guns aboard aircraft have been replaced by rockets. He claimed that rocket-carrying aircraft capable of launching nuclear rockets against "an aggressor from remote distances" are being "more widely introduced." He indicated that such rockets would be launched without entering the defense zone of enemy anti-aircraft. "This greatly increases battle possibilities of our air power," commented Malinovsky.
- **Submarines** are key elements of the fleet, and the basis of a submarine fleet is nuclear ships armed with powerful rocket nuclear arms, he said. Rocket-armed seaplanes can be used in conjunction with submarines.

Malinovsky recalled a Khrushchev statement that Soviet submarines can fire ballistic or target-seeking rockets. "Our rocket-armed subs have learned to slip under the Arctic ice and take precise positions for launching of rockets," he said. "This is very important for reliable destruction of objects on land and water." However, he stopped short of claiming that they launch from a submerged position.



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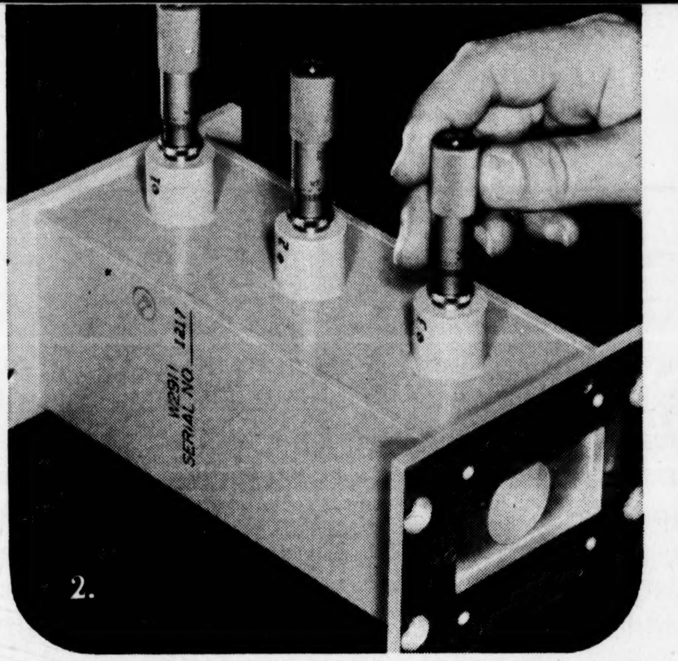

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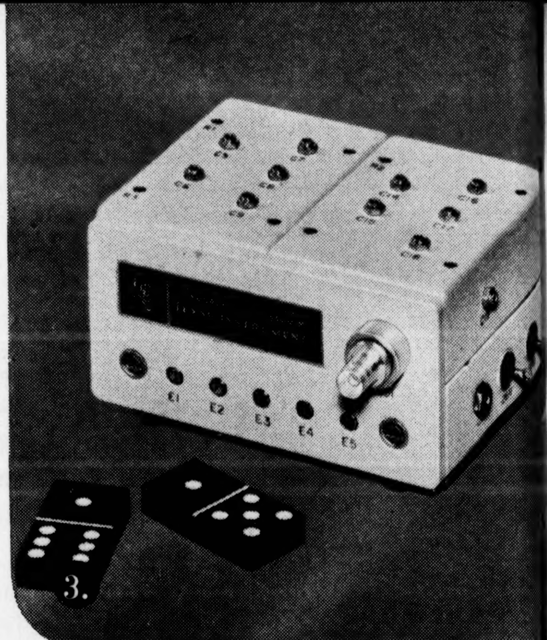

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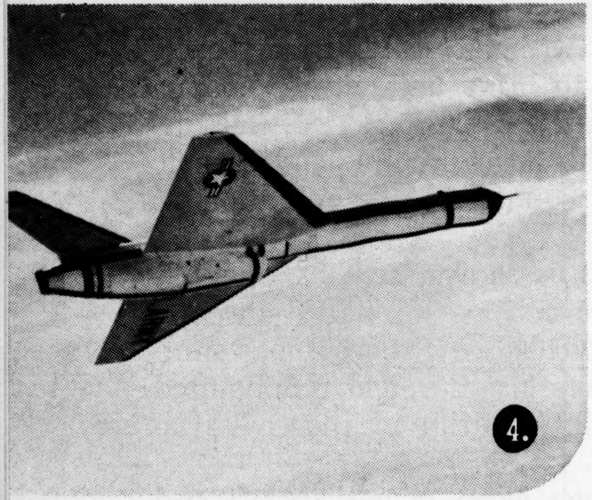
TI's RADAR CAPABILITY...



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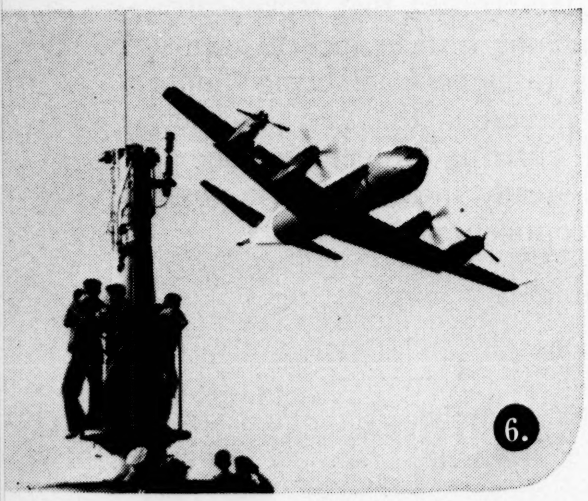

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For systems requirements, Texas Instruments now offers major advancements in microwave techniques resulting from 15 years' experience in the development and production of radar equipment. Significant technological advancements include receiver front-end improvement through the following...

1. Broadband parametric amplifiers — typical improvement in radar system noise figures possible with these devices ranges from 4 to 6 db. For comparable range improvement, using conventional techniques, it would be necessary to double antenna size or quadruple transmitter power.

2. Pre-selector filters—screen out interference from other radars.

3. Solid-state microwave sources — used as local oscillators or parametric amplifier pump sources... these devices are crystal-controlled for high stability and can be used in any application requiring a stable, reliable signal source.

Examples of TI radar systems operational today include the following...

4. Surveillance sensors for the U. S. Army Signal Corps AN/USD-5 combat drone, produced by Fairchild.

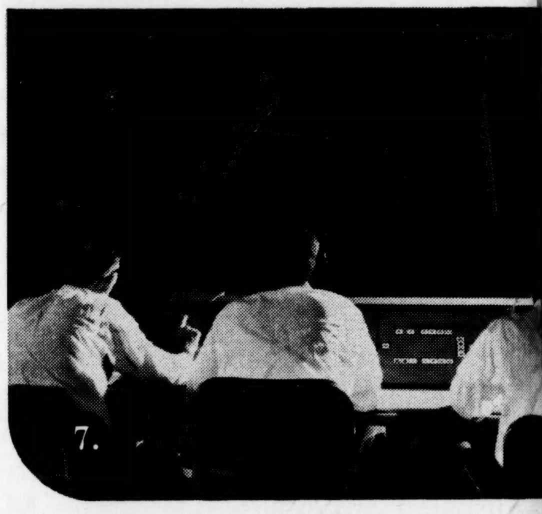
5. AN/APQ-86 reconnaissance radar in the U. S. Army Signal Corps L-23 aircraft.

6. AN/APS-80 radar and APA-125A indicator in U. S. Navy P3V ASW patrol aircraft.

7. Engagement displays for Nike-Zeus — the U. S. Army's anti-ICBM defense system, produced by Western Electric Company.

8. ASR-4 radar for Federal Aviation Agency controls airport traffic in congested areas. Display console gives clear indication of moving targets.

9. ASR-4 equipment cabinets typify system's design — all components uncover for easy servicing.



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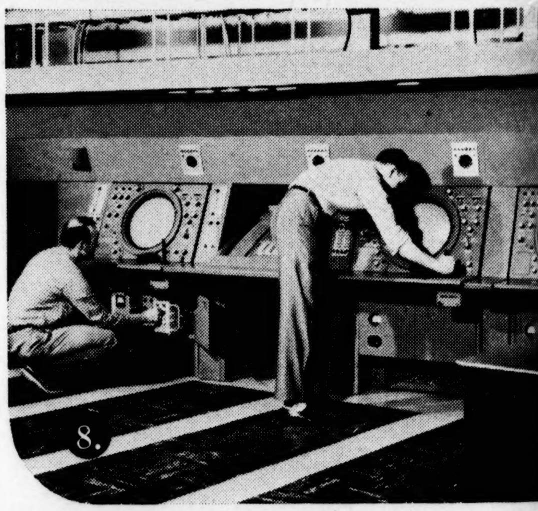

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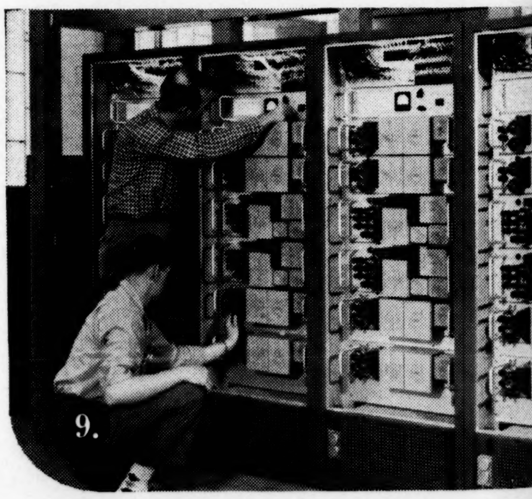

9.

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INCORPORATED
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P. O. BOX 6015 DALLAS 22, TEXAS

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WHO'S WHERE

In the Front Office

Douglas Aircraft Co., Inc., Santa Monica, Calif., has appointed the following divisional vice presidents: Aircraft Division—**W. L. Whittier**, deputy general manager; **J. O. Moxness**, commercial sales; **Leo J. Devlin**, engineering and product development. Missile & Space Systems Division—**R. L. Johnson**, product development. Tulsa Division—**J. R. Allen**, general manager.

Charles D. Manhart, vice president of the Martin Co., has been appointed head of the newly established Martin Electronic Systems and Products Division, Baltimore, Md.

Richard M. Mock, a director of Astrodata, Inc., Anaheim, Calif. Mr. Mock is a director and member of the executive committee of Lear, Inc.

Boone T. Guyton, vice president, United Manufacturing Co. Division, UMC Electronics Co., Hamden, Conn.

Leigh A. Brite, vice president in charge of the Technical Products Division, Packard Bell Electronics, Los Angeles.

James F. Healey, vice president, Aeronautical Division of Minneapolis-Honeywell Regulator Co. Mr. Healey continues as general manager of the division's St. Petersburg, Fla., plant.

H. G. Conway and **R. E. Harvey,** joint managing directors of Short Brothers & Harland, Ltd., Belfast, Ireland.

John F. Jacobs, assistant vice president-technical operations, the Mitre Corp., Bedford, Mass.

Brig. Gen. Walter E. Arnold, chief of staff, Tactical Air Command, Langley AFB, Va. **Lt. Gen. G. A. Blake**, commander, Continental Air Command, Robins AFB, Ga. **Lt. Gen. W. H. Blanchard**, the inspector general, USAF. **Maj. Gen. W. M. Momyer,** director of operational requirements DCS/Operations, USAF.

Honors and Elections

Martin M. Decker, president of Decker Corp., has been elected president of the National Aeronautic Assn., succeeding **Jacqueline Cochran**, now board chairman of NAA. **Roger Feming** of the Allison Division of General Motors succeeds Mr. Decker as senior vice president.

Changes

Richard T. Baseller, assistant engineering manager, Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn. Also: **Walter Doll**, chief engineer-advanced power systems; **Donald J. Jordan**, chief engineer-advanced powerplants.

General Dynamics/Astronautics, San Diego, Calif., has appointed the following executives to the Advanced Product Planning Department: **John J. Crowley, William K. Brehm, Bruce McKay** and **Thomas W. Wills.**

Dr. Yardley Beers, chief, Millimeter-Wave Research Section, Radio Standards Laboratory, Boulder Laboratories, National Bureau of Standards, U. S. Department of Commerce.

INDUSTRY OBSERVER

▶Space Task Group expects to complete technical evaluation of the five Apollo spacecraft bids this week at Langley Field, Va. Business and economic evaluations will be completed early next month, and NASA may award the contract in late November or early December.

▶Two Lockheed U-2 aircraft have been assigned to the Atlantic Missile Range to obtain infrared baseline data during launch of all missiles. The aircraft, equipped with infrared sensors, were scheduled to monitor first launch of the Saturn booster.

▶Recovery of large boosters using generation of lift on a circular cylinder is being studied by the National Aeronautics and Space Administration. Sizable lift can be obtained with a small, conventional flap or a jet flap on a rocket aligned with the thrust axis perpendicular to the relative wind. The entire rocket acts as a lifting surface with a high aspect ratio.

▶U. S. engineers analyzing photos of the latest Soviet Mil flying crane (AW Oct. 9, p. 25) believe the landing gear is new, lighter and better than the earlier system. Purpose of light truss work extending from the cockpit to each front gear is unclear but one theory is that it serves as a hydraulic balancing device. Rotor hub design appears to be the same as on the Mi-6 helicopter, but the Mi-6 apparently has followed U. S. practice in shifting to untapered blades to simplify production. Crane's blades may have been a set of earlier, tapered Mi-6 blades with a section added for length.

▶High-power reactors, with outputs up to 20,000 megawatts and thrust levels over 1 million lb., are in the long-range plans of the joint Atomic Energy Commission-NASA Space Nuclear Propulsion Office. This system would be used as a booster stage for planetary flights.

▶All electrical propulsion work in NASA is being shifted to Lewis Research Center, consolidating work formerly done at Lewis and Marshall Space Flight Center. Dr. Ernst Stuhlinger, who headed the Marshall work in this field, reportedly plans to leave NASA for an industry job. Headquarters management will come under Harold B. Finger, nuclear propulsion director.

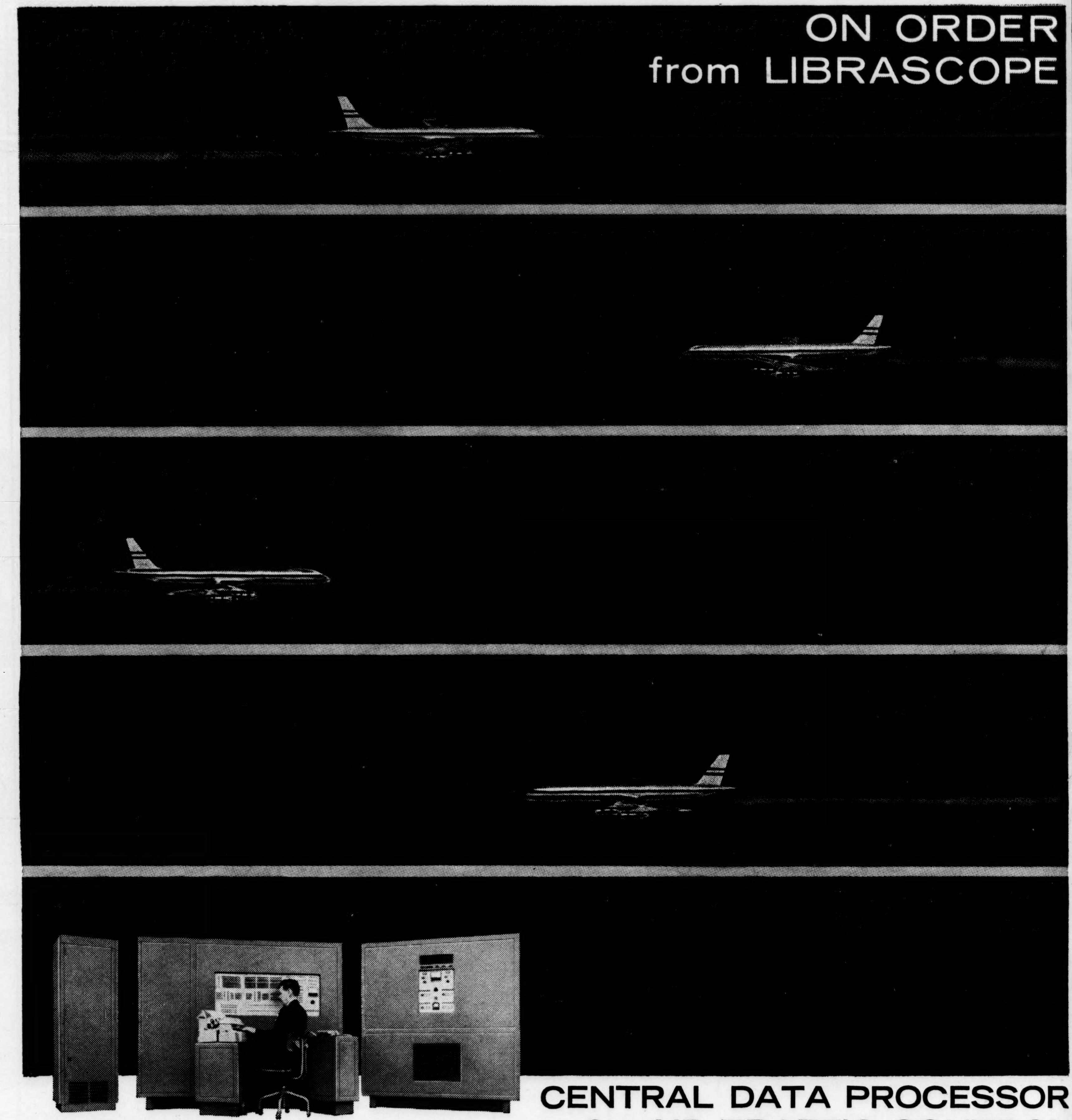
▶First launching of a Titan II, which is to be used as a missile, a Dyna-Soar booster and probably for Mk. II Mercury capsules, now is scheduled for the first quarter of next year—probably in February. First firing had been scheduled before the end of this year.

▶Dive brakes on Canadair's CL-41 trainer will be modified as a result of flight experience gained during the aircraft's European tour. The F-86 type brakes will be made to deflect through a larger angle from the fuselage to increase effective frontal area, and dimensions will be enlarged slightly, but not enough to require a change in trim.

▶Boeing Co.'s approach to big booster design favors liquid propellants and use of conventional materials in rigid, semi-monocoque structure. Company has experimented with chemically-milled, waffle aluminum half-cylinder sections approximately 12 ft. in diameter. Structure could be used for solid propellants. Aerolasticity might represent a more severe problem with big solid segmented boosters than with liquids, in Boeing's view. Even a fairly rigid solid structure like Minuteman with minute amounts of aerolasticity presents guidance problems. This factor, plus a possible performance edge with liquids, are Boeing's reasons for favoring the latter propellants.

▶Scout launching pad being built at Pacific Missile Range at a cost of $270,000 is expected to be ready for use next April. Another pad for space probes, located 1,200 ft. away, is due to be completed the same month. It will handle boosters with thrusts up to 150,000 lb.

▶Poland intends to build a nuclear-powered ship and has begun courses at Gdansk for the engineers who will design, construct and commission the vessel.



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Washington Roundup

Mercury Designs

National Aeronautics and Space Administration is studying at least three configurations for advanced Mercury spacecraft, but is relatively firm only on the design to equip the adapter section with additional oxygen for a 17-orbit mission.

Another possibility would be expanding the size of the capsule by one-third to accommodate two pilots. Third idea is to add six flaps to the blunt end so capsule could be maneuvered during re-entry. Capsule would be designed to carry two men—rather than primates as now planned—on missions up to 14 days. Apollo components would be tested and rendezvous techniques developed with the larger capsule. Other uses would be to test attitude controls and vector selection procedures for lunar landings.

Some space leaders would rather use astronauts for the 14-day mission instead of the two monkeys and chimpanzee originally planned. Question is whether risks can be reduced to point where manned flight is justified.

NASA Education Plan

Pattern for National Aeronautics and Space Administration relationships with universities has now been set. Approach is designed to break down traditional barriers between government and university scientists working in the same general field.

NASA Administrator James E. Webb told Aviation Week "a flowering of thought" will result from getting NASA and university astronomers, for example, to work on the same problem. NASA space probes and other techniques will gather new information which, it is hoped, university professors and their students will apply to space problems in their own laboratories.

First formal attempt to effect this program came last week when NASA announced it had given the Midwest Research Institute in Kansas City, Mo., $225,000 to stimulate university and industry interest in the space program. Institute will visit midwest universities to talk about NASA's program. Next month NASA leaders, as part of this same effort, will meet with California college and university presidents to discuss ways the educators can achieve closer ties with the space program.

Contract Studies

Congressional demands for better management of the military contracting program has sent Pentagon officials afield to study how private industry handles similar problems.

Team from Air Force Inspector General's Office already has visited Rocketdyne Division of North American Aviation, Inc., will now go to several other aerospace firms. Gen. Curtis E. LeMay, Air Force Chief of Staff, ordered the field trips because he was impressed by the results of the first such study made last December at the Martin Co. Denver Division where the Titan system is being developed.

Assistant Secretary of Defense John H. Rubel is heading another study to improve both military and industry management of development programs. Robert Tucker, formerly a project engineer for Hughes Aircraft Co., will try to improve management within the Office of Defense Research and Engineering. He recently became plans and programs director there.

Watch for NASA to establish within its new Aeronautical Research Division (see p. 25) a special branch on civilian aviation.

Rover Publicity

Space Nuclear Propulsion Office has told Rover contractors that its "over-all policy" in releasing information about the program "is that emphasis will be placed on positive accomplishments such as the achievement of milestones" rather than glowing accounts of possibilities.

Harold B. Finger, manager of the Joint Atomic Energy Commission-NASA office told Aviation Week the Rover program "has a lot of potential but the real question is what we are doing now to get it done." He said "We'll talk about problems as well as successes," but felt publicity guidelines were needed to discourage industries from ballooning possibilities rather than solid achievements.

First detailed estimates of the manpower demand and supply created by the space program will be included in the Golovin Committee's report (see p. 22) on what course the U. S. should take in the booster field.

Space agency leaders say the manpower facts will figure heavily in deciding what space projects to undertake. NASA already is pondering ways to get industry to make better use of its present aerospace talent.

Significant but largely unnoticed statement buried deep in recent speech by Deputy Secretary of Defense Roswell L. Gilpatric: "Our planners are working on . . . possible military uses of space."

—Washington Staff

Solid Booster to Be Developed for USAF

Golovin Committee approves; $500-$600 million project could produce Dyna-Soar, Advent vehicles.

Washington—Defense Department is ready to approve allocation of initial funding for the development of a 120-in.-dia. solid propellant rocket motor for the Air Force (AW July 31, p. 33). The full four-year development program is expected to cost $500-600 million.

This action is expected to be taken following a presentation by USAF Systems Command and Aerospace Corp. to Defense Secretary Robert S. McNamara, Dr. Harold Brown, director of Defense Research and Engineering, and his deputy, John Rubel. Previously, the Large Launch Vehicle Group, known as the Golovin Committee (AW Sept. 4, p. 35), was briefed on USAF plans and indicated its approval.

The joint Air Force-National Aeronautics and Space Administration Golovin Committee, established to recommend the course of the large launch vehicle program, is scheduled to make its report this week. It is headed by Dr. Nicholas E. Golovin, who becomes director of systems engineering in NASA's Office of manned Space Flight Programs on Nov. 1.

Initial Funding

Initial funding is expected to be about $77 million. Approximately $50 million will be allocated for rocket motor development, $12 million for construction of facilities, and $15 million for research in thrust vector control, ignition schemes and other basic system areas.

These are preliminary funding estimates on subsequent development:

- **1963**, $120 million for hardware, $94 million support.
- **1964**, $177 million hardware, $40 million support.
- **1965**, $136 million hardware, $25 million support.

Air Force interest in the 120-in.-dia. motor stems from its potential in the Project Phoenix large space booster program (AW Mar. 27, p. 50), in which the basic solid propellant booster would be used in combination with other solids and high energy liquid propellants. Other possible uses are in the Dyna-Soar boost-glide program, with a pair of rockets strapped to the Titan II booster, and as a booster for the Army's Advent communications satellite, for which Air Force is supplying the launch vehicle.

There is some feeling that if a 120-in.-dia. solid propellant motor can be developed quickly, it could be given many of the missions now assigned to the Atlas-Centaur vehicle. Atlas-Centaur has experienced several serious delays in its development program (AW Oct. 23, p. 22), and it may be unable to accommodate the Advent payload weight.

The Air Force program is not viewed as conflicting with the NASA program for the development of the Nova solid propellant vehicle, since NASA is seeking solid motors with diameters of 156-240 in. for its Nova vehicle. USAF will develop a 20-million-lb. thrust solid propellant vehicle to NASA specifications under a May 25 executive order.

Solid rocket proponents feel, however, that NASA will emphasize liquid propellant vehicles for Apollo manned lunar landing mission and that the Air Force is in an excellent position to strengthen its space role by developing a 20-million-lb. thrust solid propellant vehicle before NASA's liquid Nova vehicle is ready (AW Oct. 23, p. 21).

The Air Force 120-in.-dia. motor probably will be developed in five-segment and three-segment configurations. These would be parallel developments, but may be performed by the same contractor since the larger design will be a simple extension of the three-segment configuration by adding two identical middle segments.

The larger configuration would have a gross weight of about 450,000 lb., and be 60-65 ft. high. Thrust would be 1.4 million lb., and burning time, about 120 sec. Specific impulse probably will be 240-245 sec. and the propellant mass fraction is not expected to exceed 0.85. USAF favors fluid injection for thrust vector control.

Development Schedule

Development schedule for the three-segment configuration initially would involve six motors. Four would be used for preliminary flight readiness testing (PFRT), which would start in September, 1963. Main flight test program, involving about 15 motors, would begin early in 1964.

Initial development for the five-segment configuration would involve seven motors. A six-motor PFRT program would begin in February, 1964, and a 10-motor flight test program would start three months later.

As a prelude to this development program, USAF now is receiving industry proposals for a development of a single segment, 120-in.-dia. motor. Any award in this competition probably will require a first firing by November, 1962.

Competitors for the 120-in. rocket, as well as for the solid propellant Nova which USAF is developing to NASA specifications, are Aerojet-General Corp., Grand Central Rocket Co., Thiokol Chemical Corp., and United Technology Corp.

One of the major pacing items in large solid propellant flight tests is construction of launch facilities. It is expected that USAF and NASA will jointly use the launch facilities to be built for large boosters at the Atlantic Missile Range (AW Aug. 28, p. 30).

Mississippi Picked for Saturn, Nova Test Site

Washington—Saturn and Nova static test site will be located on a 13,500-acre tract in southwest Mississippi about 35 mi. from the Michoud, La., facility where the large boosters will be built.

The National Aeronautics and Space Administration last week said it will buy the tract and obtain easements on 128,000 acres surrounding the test site as a buffer zone. The agency expects to pay $13.5 million for land acquisition and easement rights.

At least six stands, capable of accommodating boosters from 1.5 million to 20 million lb. thrust, will be built at the site during the next three years. Construction will start next spring. The site is accessable via the intercoastal waterway and Pearl River for barge transportation of boosters from Michoud.

The buffer zone is located in Pearl River and Hancock Counties, Miss., and Tammany Parish, La. About 575 homes are located in this zone, and the government will allow residents up to 30 months to move. Farming, grazing and lumbering activities can continue there, but no homes will be permitted.

About 85 residents now living in the test site tract will be moved by next spring.

The site will employ 500 to 1,000 persons, and will be operated by NASA's Marshall Space Flight Center.

NASA said the Pearl River tract was one of 30 sites on the Gulf Coast considered for Saturn and Nova static tests.

NASA currently is acquiring an 80,000-acre tract adjoining the Atlantic Missile Range on which at least six large launch complexes will be constructed.

Three will handle liquid boosters with thrust ranges to 12 million lb., and the other three are being designed for solid propellant boosters, with thrusts to 20 million lb.

USAF may decide to construct static test facilities at the Edwards AFB Rocket Test Site, or as an alternative, request that NASA include its requirements in the giant Pearl River, Miss., static test facility it will acquire (see box).

Contract Awards

Meanwhile, Aerojet-General Corp. and Rocketdyne Division of North American Aviation, Inc., have been awarded $185,000 contracts by NASA to study new techniques for building large liquid propellant boosters ranging in thrust from 2-24 million lb.

Both companies will study oxygen-hydrocarbon and oxygen-hydrogen propellant combinations. If a superior design concept results, the companies will establish design criteria and geometry for a large engine. The contracts will run for 10 months.

USAF Fighter Units Moved Back to France

Wiesbaden—U. S. Air Force tactical fighter units are moving back into France for the first time since the fall of 1959 as part of the buildup of USAF striking power in Europe in the face of the Berlin crisis and as available runway space elsewhere becomes more overcrowded than usual.

Presumably, the aircraft at the six bases will not be allowed to bring their nuclear weapons stores with them because of a French prohibition that resulted in the pullout of Air Force F-100 tactical fighter units in 1959.

Announcement of the re-opening of the French bases, five of which have been on caretaker status, coincides with the Defense Department order of 11 Air National Guard squadrons to Europe—three equipped with Lockheed F-104As, three with North American F-86Hs and five with Republic F-84Fs. The three F-104 units will replace three similarly equipped Tactical Air Command squadrons that have been stationed in Europe on a temporary basis for the past several weeks. These will be returned to the U. S.

Re-opened French bases are at Dreux, Chambley, Etain, Chaumont and Phalsbourg. The sixth base, Toul-Rosieres, had continued as an operational base for a Douglas RB-66 reconnaissance unit.

Air Force and Douglas Accelerate Skybolt Ballistic Missile Program

Washington—Air Force has sharply upgraded the GAM-87A Skybolt air-to-surface ballistic missile program by expanding military and contractor staffs and placing responsibilities at higher organizational levels.

These developments followed a year of delays, altered specifications and indecisions as to the worth of the weapon system which is designed to provide a standoff weapon capability for the Boeing B-52H and British Vulcan heavy bomber:

- **Placement of program** direction in the hands of Brig. Gen. David M. Jones, the vice commander of the Aeronautical Systems Division of the Air Force Systems Command at Wright-Patterson AFB, Dayton, Ohio.
- **Creation of a Skybolt** Systems subdivision of the Douglas Aircraft Co.'s Missiles and Space Systems Division at Santa Monica, Calif. Director of the subdivision is John L. Bromberg, who is also assistant general manager of the division.
- **Increase in the size** of the System Program Office at ASD and shift of a portion of the SPO to the Douglas plant.
- **Increase in size** of the project organization at Douglas from 950 to 2,000.

A special program direction team from AFSC headquarters at Andrews AFB, Md., near here, is now at the Santa Monica plant supervising the reorganization. Its work will be completed early in November.

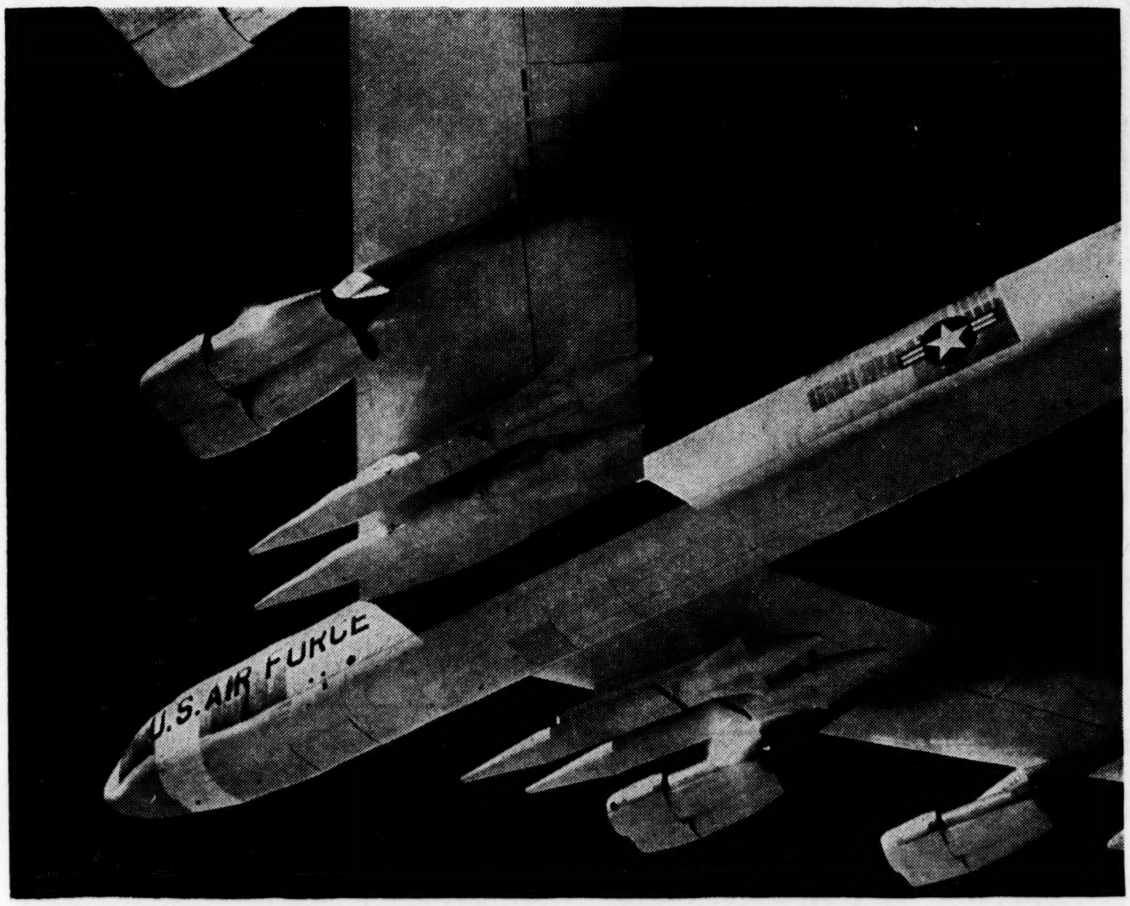
Funding of the program has been increased by an undisclosed amount.

Testing Program

The minimum test program as now planned stands at four "captive mechanicals," missiles which will not be fired but will be tested for airframe worthiness, one "captive electrical," which will be used to test the electrical system, and three guided vehicles which will actually be fired.

All missile tests except "hot" firings—actual flights—will be conducted from the Air Proving Ground Center, Eglin AFB, Fla. Hot firings will be conducted over the Atlantic Missile Range and controlled from Cape Canaveral after takeoffs from Eglin. Tentative date for the first hot firing is July, 1962.

Pressures from within the Air Force and from Great Britain were responsi-



New Skybolt Configuration Fitted to B-52H

Latest USAF Skybolt (GAM-87) configuration recently was fitted to B-52H at Boeing Co.'s Wichita, Kan., facility. The inert missiles are to be delivered to Edwards AFB, Calif., for performance testing there. Earlier Skybolt nose cone, which was a preliminary selection, chosen before warhead was firmed, was known as sphere-cone-cylinder-flare configuration. This describes it starting from the tip and going aft. New configuration is a design optimization based on consideration of many functions including warhead weight, nose cone center of gravity, trajectory, arming, etc. and is known as a sphere-cone configuration.

Douglas Shows Profit

Douglas Aircraft Corp. showed a net profit of $4,485,938 on sales of $616,217,249 for the first nine months of its 1961 fiscal year compared with a net loss of $21,868,045 on sales of $858,993,000 for the same period last year.

Backlog as of Aug. 31 was $784 million: $149 million in commercial work and $634 million in military. Backlog at the end of 1960 was $1,030 million.

The Douglas board, at its quarterly meeting, took no action on a dividend, which has been omitted since the company began showing deficits in 1959 because of its DC-8 write-offs.

Resignation of Lt. Gen. Ira C. Eaker (USAF ret.) as a director and vice president of the company's Eastern offices was accepted by the board.

ble for the increased emphasis placed on the program.

Increased potential of the Russian defense system against manned aircraft in the time period from 1964 on has made the Skybolt system more desirable. A B-52 carrying four of these missiles could clear defenses from its approach path to a target it planned to hit with other weapons, or it could attack its target from afar with the Skybolts.

The Royal Air Force wants Skybolts, for the same reasons, for its Vulcan.

A year ago the program was in jeopardy when the Eisenhower Administration budget request for Fiscal 1962 did not include new obligational authority for Skybolt. Great Britain, which is a financial partner in the project, was alarmed at this development which threatened to leave its bomber without a standoff weapon.

Air Force kept the project alive by stretching Fiscal 1961 funds into 1962, but there was slippage due to the reduced funding. Other delays were due to the necessity of re-examining the project goals. Defense Department officials considered the range and accuracy requirements too strict and ordered they be eased.

The Air Force was thus faced with either placing sufficient emphasis on the project to have the weapon available by the desired target date, or have its B-52s, which by that time will be obsolescent, operating without standoff weapon protection.

By locating Skybolt program direction under the ASD vice commander, the Air Force has placed greater relative priority on it than all but one other system. Ordinarily, the system program directors in ASD operate under a deputy commander. A special category was created for the B-70 supersonic bomber by appointing a special deputy commander for that project alone. This type of priority also holds true for the Minuteman solid propellant intercontinental ballistic missile where a deputy commander of the Ballistic Systems Division is the program director. The Samos reconnaissance satellite system at the Space Systems Division is also under a vice commander.

The buildup of personnel at Douglas will affect the engineering force, service department, data submittal group, training force and publications office.

Skybolt systems direction within the Douglas Missiles and Space Systems Division has been divorced from other programs, such as Saturn and Nike Zeus. As assistant general manager, Bromberg had also been program director for all programs. Now his sole responsibility is to provide both technical and business management for the Skybolt program.

His deputy director of the Skybolt systems subdivision is C. S. Perry, and Harold E. Brauer is assistant to the director. Connected directly to the director's office is the manager of administration and the planning staff manager.

The new subdivision has two prime functions; to provide system management for the Skybolt program, and to provide management for the Douglas internal tasks of development and production of the airframe and of system assembly and test.

All personnel who are working full time on Skybolt, no matter where located in the division, will be transferred to the subdivision. Where there is overlap with other programs, a final decision on the transfer will be made during the subdivision formative stage.

Four managers will report to the director. Systems Engineering and Technical Direction manager will be W. T. Hunter. The organization which will carry out operations and weapon system configuration control for Hunter will be composed of systems engineering personnel from Douglas and major subcontractors. Manager of Operations will be K. R. Williams. His organization will handle contract and subcontract administration, budgeting, scheduling, facilities, program operating procedures.

W. W. Benbow will be manager of Weapon System Configuration Control. His responsibility covers the operational configuration status of components as well as the system and will control all changes in the system. Completing the managerial organizations is Airframe, Assembly and Test, under W. L. Duval.

The three principal subcontractors for the Skybolt program are Aerojet-General for the solid propellant propulsion system, General Electric Missile and Space Vehicles Division for the reentry vehicle, and Nortronics Division of Northrop Corp. for the guidance system. Associate contractors are Bendix for development of a ground support unit and A. V. Roe, developers of the Vulcan bomber.

General Dynamics May Merge Two Divisions

Los Angeles—General Dynamics Corp. may soon merge its Pomona and Electronics Divisions into a single organization probably to be known as its Missiles and Electronics Division. Consolidation would be a result of extensive revaluation of the missions and product lines of the two General Dynamics organizations.

Charles F. Horne, head of the Pomona Division, presently has coordinating and administrative control of both divisions since the resignation several weeks ago of James D. McLean who was president of General Dynamics/Electronics. Horne is expected to continue as head of the combined organization superseding the two divisions.

One probable consequence of current studies may be the withdrawal of General Dynamics from its financially disappointing participation in the field of checkout equipment in which General Dynamics/Electronics, and Stromberg Carlson before it, were active.

Ranger 2 Postponed

Cape Canaveral—Launch of Ranger 2 has been postponed until late next month in order to compare data from the unsuccessful launch of Discoverer XXXIII with the Agena B stage in the Ranger B launch vehicle.

The Ranger launch had been postponed previously because of systems malfunctions, first in the Atlas booster and then in the Ranger spacecraft. Decision to postpone the launch beyond the prescribed time-period, which extended until last Friday, was made after the Discoverer failure.

Ranger 2 will be the last launch in the series with the mission to conduct a deep space radiation survey. Three Rangers will be launched next year and will be designed to make hard lunar landings.

Emphasis in the Ranger lunar landing series is shifting to support the Apollo manned lunar landing missions, and four Ranger spacecraft planned for 1963 will contain television equipment designed to obtain pictorial data for Apollo flights.

In another change, more shielding and sensors will be used to determine the hazards of solar flares.

Ranger 1, launched Aug. 23, went into a low earth orbit rather than a highly elliptical orbit because a faulty Agena B pressure switch stopped the fuel flow after the spacecraft had been in a parking orbit 14 min. A Lockheed spokesman said the failure was the first traced to a propulsion system in the history of Agena B flights.

NASA Forms Four Major Program Offices

By Edward H. Kolcum

Washington—An organization unique in the government, designed to exploit proven industrial management techniques, will become effective this week in the National Aeronautics and Space Administration.

Top tier of the new organization was announced by NASA late last month (AW Oct. 2, p. 32). In detailed studies since the decision was made to reorganize, the agency has developed a matrix-type structure, so-called because it centers both staff and operational responsibilities in four tightly-organized major program offices. The net effect, NASA feels, will be an elimination of intermediate decision-makers and a consolidation of management responsibility.

Field centers will function much like industrial operating divisions, and each of the four program chiefs will have authority to assign tasks to any of the field centers. Program directors and field centers, all reporting to Dr. Robert C. Seamans, Jr., associate administrator, will have independent rights of appeal. Dr. Seamans' function will be one of agency general manager.

Program offices will perform staff jobs in defining technical objectives and in defending funding requirements. Once program decisions have been made, directors become day-to-day operational managers.

Comparison of Systems

In the former NASA organization, headquarters served essentially as a staff element, with general direction responsibility for programs. Field centers were divided among the office directors. All centers now have direct access to Seamans, and it is likely that the agency's research centers will be given an increasing role in development.

Although some key personnel assignments had not been made by the agency late last week, these details of the new organization were in the final stages of consideration:

- **Manned space flight,** to be headed by Brainerd Holmes, who will have five offices. They are Vehicles, to be headed by Milton W. Rosen; Spacecraft, George W. Low; Bioastronautics, Brig. Gen. Charles H. Roadman, USAF; Systems Engineering, Dr. Nicholas E. Golovin, and Finance, William E. Lilley.
- **Advanced Research** and Technology, to be headed by Ira H. Abbott and to include all basic work not mission-oriented. Major programs will be Aeronautics, to be headed by John Stack; Space Sciences, Milton B. Ames, Jr.; Nuclear Systems, which includes electric propulsion programs, Harold B. Finger; Research, which includes all basic and state-of-the-art activity, Dr. H. H. Kurzweg; and Guidance and Electronics, Navy Lt. Cdr. Albert J. Kelley.
- **Applications,** no director named. Major offices will be Space Systems, which are communications, weather and navigation satellites; and offices designed to distribute and exploit for the U. S. economy the practical benefits of space exploration.
- **Space Sciences,** to be headed by Dr. Homer E. Newell, Jr., with Edgar M. Cortright as deputy. Dr. Newell will direct all scientific satellite and probe programs, and sounding rocket activities.

A separate headquarters service element for Tracking and Data Acquisition is to be formed under Edmond C. Buckley. This element will support activities of all program offices.

Significant Appointment

One of the more significant aspects of the new organization is appointment of Stack to head a centralized aeronautical research division. Stack, assistant director of NASA's Langley Research Center, is a leading authority in aeronautics and high speed flight and has spent 32 years in government research.

The Wiesner Committee (AW Jan. 16, p. 26) and conclusions of the Federal Aviation Administration's Project Horizon report (AW Sept. 11, p. 34) urged more NASA emphasis on aeronautics, but the agency did not establish a separate aeronautical programs office because James E. Webb, the administrator, did not want to compartmentalize research.

However, the new office is expected to bring together aircraft-oriented research which had been under separate program offices.

The organization also reflects the first concentrated attempt by NASA to make available the benefits of space exploration to the U.S. market. Advanced production and handling techniques, materials, fabrication, instrumentation and basic knowledge developed in the space program have been delayed in going from the government to business and industry, and the Applications Office will explore ways to speed the process.

Although this office does not yet have a director, John J. Burke, executive vice president of the Siegler Corp., has been acting as a consultant in its organization. There was speculation that Burke would be appointed director, but he has said he expects to leave NASA for his permanent job in three to four months.

NASA last week appointed another consultant, Dr. Hiden T. Cox, who will become assistant administrator for public affairs and will coordinate the agency's public statements.

Information Coordinator

A botanist, Dr. Cox has taken a six-month leave of absence from his job as executive director of the American Institute of Biological Sciences. His job will include coordinating technical and public information released by the offices of Legislative Affairs, Public Information, Technical Information and Education and International Programs of NASA.

Reorganization of NASA was the subject of several independent studies conducted last year while Keith Glennan was administrator. The need became more pressing with President Kennedy's decision to vastly expand the space program and to make manned lunar flight a national objective. The old organization was considered inadequate to manage the rapidly-growing space budget, which next year will amount to $3.7 billion.

The agency considered organizations similar to the Navy's Special Projects Office, which manages the Polaris program; Air Force System Program Office structure, which manages space and weapons systems, and various independent management techniques such as Aerospace Corp. NASA considered that none of these organizations would work well on a long-term basis and based its organization on the matrix philosophy, which it feels is fluid enough to adapt to changes in research and development emphasis.

Navy Awards Contract For Shrike Missile

Washington—Navy has awarded a contract for $1,570,504 to Texas Instruments, Inc., Dallas, Tex. for engineering and manufacturing of guidance and control assemblies of developmental models of the Shrike air-to-surface anti-radiation missile.

Shrike, formerly known as the ARM missile, will have homing capabilities against radar and other electromagnetic emission installations.

The over-all system is being designed and developed by the Naval Ordnance Test Station, China Lake, Calif. Guidance system for the missile will be essentially the same as the larger and longer range Corvus missile, whose development was canceled by the Navy as part of an economy move in July, 1960.

U. S. Moves to Upgrade Military Research

By George C. Wilson

Washington—Dr. Harold Brown, director of Defense research and engineering, in his recent speech calling for better management of military laboratories signified the new urgency President Kennedy has given to an old question: How to get first-rate research on second-rate salaries?

This question—as well as some of the Pentagon's answers to it—also bothers several leaders in Congress. Their concern probably will lead to hearings early next year on the general federal salary system and on specific steps the services have taken to circumvent it, such as establishing non-profit laboratories with high-paid personnel to do military research.

Chairman George P. Miller (D.-Calif.) of the House Science and Astronautics Committee, for example, will press Congress to provide a new pay scale for government scientists and engineers with annual salaries up to $20,000, compared with the current $18,500 maximum allowed under the civil service system. (A limited number of scientists and engineers can be paid $19,000 under current law.) Rep. Miller on Sept. 26 introduced a bill to establish this new pay scale, and President Kennedy is expected to give it vigorous support.

Rise of Non-profit Labs

As for non-profit research laboratories, both the Administration and Congress are worried about the increasingly large role they are playing in Defense decisions. Brown on Oct. 19 said such laboratories were "a tremendous asset to the Defense Department's research and development program, but they must operate within a clearly defined system of constraints."

Chairman F. Edward Hebert (D.-La.) of the House Armed Services Special Investigations Subcommittee told Aviation Week there was "a good possibility" his group would resume its hearings on Defense Department contracts with both profit and non-profit laboratories. He wants to determine if they are worth the investment and whether they are assuming responsibilities which should remain with military leaders.

Federal spending for research by non-profit firms and colleges is largely a post World War II phenomenon. These non-profit organizations have received billions from the federal government. The National Science Foundation, in its analysis of the government's Fiscal 1961 budget, categorized the $7.9 billion scheduled to be obligated for research, not counting plant expansion. It reported $4.9 billion was to be spent by profit-making firms and their research centers; $1.9 billion by the government itself in its own laboratories and other research centers; $879 million by educational institutions; $157.4 million by non-profit organizations; $88 million by foreign countries, and $21 million by miscellaneous groups.

The Defense Department was scheduled to spend the biggest share of the $7.9 billion research total—$5.5 billion. Of that amount, Defense planned to spend about $289 million on contracts with universities and other non-profit institutions, according to the Foundation study. Defense Department estimates from its later studies that about $374 million of its research money went to non-profit groups in Fiscal 1961.

Generally cited justification for contracting out so much federal research is the Defense Department directive issued in 1953 (Directive 4100.15) which stated the Eisenhower Administration policy was to use government facilities only where it could be clearly demonstrated that private enterprise could not perform the service or provide the product necessary to meet current and mobilization needs, or that operation by the government was necessary in the execution of the military mission.

During hearings on Defense Department contracts this year, Rep. Hebert said: "Now we come up eight years later, and we have no figures to show whether it was in the interest of the government or not in the interest of the government" to carry out the 1953 directive. His subcommittee hearings focused on several Defense Department research contracts of an unusual nature. These are some examples of the research contracts:

- **Bryn Mawr College**, $22,360 to study, according to the contract, "psychological adjustment factors in self estimate of body space." Testimony developed considerable support for this study, which basically is designed to help determine the best cockpit design for astronauts in a state of weightlessness.
- **CEIR, Inc., Research Center** of Los Angeles, $1.4 million to study for five years (beginning Apr. 1, 1958 and ending Mar. 31, 1963) and then recommend a "war game" with rules "sufficiently clear and simple that the game can be played with little or no special training." Signal Corps witnesses explained the contract, instead of requiring recommendations for the conventional type of war games, involved testing and evaluating all kinds of communications equipment to determine best systems for combat conditions.
- **Opinion Research Corp.**, Princeton, N.J., $40,000 for six months' study "designed to enhance West Point's ability to attract highest quality candidates from throughout the U. S." The contractor is to "recommend communication methods for motivating outstanding students to seek admission to West Point." Army awarded the contract in February, 1961.
- **Dunlap & Associates, Inc.**, Stamford, Conn., $74,386 "to conduct research on the analysis and prevention of motor vehicle accidents to off-duty military personnel." Army witnesses said this was the third contract in a series on the same subject. The same firm received two separate contracts of $66,874 and $85,321 between 1955 and 1958 for a total of $226,581 to study accidents involving off-duty military personnel. After questioning Army witnesses on the contracts, Rep. Hebert said: "Well, I think we can come to the conclusion that there are automobile accidents. I think that is the proper conclusion."

Congressional Skepticism

Although the House subcommittee's investigation was limited and failed to stay on any one contract long enough to develop a detailed case, the hearings did bring out the frustration members of Congress feel about these research "think" contracts. Lawmakers want to see dollar justification for spending. But none of the military or professional witnesses could satisfy them on this point during the hearings. Dr. Charles Hutchinson, deputy director of life sciences in the Air Force Office of Scientific Research, in describing the Bryn Mawr contract tried to explain why solid justification could not be given for basic research contracts:

"We are interested in those kinds of work which will develop new concepts, which will make discoveries and inventions and develop materials or procedures which will be helpful to the Air Force 10, 15 and 25 years into the future. And therefore we don't pretend that we are coming up with a gadget or piece of useful information that will be used next week."

Congress has showed sympathy for this point of view by appropriating generously for research and development. But congressional skepticism about so-called think contracts and non-profit laboratories established by the government to do its work is deepening. Consequently, President Kennedy's research budget for Fiscal 1963 is certain to undergo an especially close scrutiny when it reaches Congress next year. House appropriations committee earlier this year criticized the Air Force's research facility, Aerospace Corp., noting that salaries there far exceeded those paid by the government to its own employes for the same work (AW July 10, p. 85, Aug. 7, p. 52).

A move to limit salaries paid by non-profit firms like the Aerospace Corp. failed after House Majority Leader John W. McCormack (D.-Mass.) argued "Congress should not prejudge current Defense Department trends in the use of non-profit organizations. . . . It is necessary that we study the matter further and above all not take hurried action that could possibly jeopardize our missile and space programs. . . ."

Costs Are Criticized

Although supporting this view, Chairman George H. Mahon (D.-Tex.) of the House Appropriations Defense Department Subcommittee said "we are moving toward a state of chaos and irresponsibility in this [non-profit] field, and somebody with a firm hand is going to have to watch the situation very carefully." House appropriations committee report said Aerospace Corp. salaries "are excessive," overhead costs "are too high," and it plans to employ "too large a staff." The committee told the Air Force to spend no more than $30 million in Fiscal 1962 for the corporation's work, $5 million less than the requested amount. However, an amendment to put this restriction into the bill itself was voted down on the House floor June 28.

Faced with this congressional criticism, President Kennedy, Aug. 6, directed the Budget Bureau to review contracting-out policies and report recommendations by Dec. 1, 1961. The President said the study should focus on the effect contractors have on federal operations; policies federal government should follow in controlling salaries of those working under contract; criteria for determining whether the government or an outside contractor should perform the work desired; policies for selecting contractors and organizing such firms as the Aerospace Corp.; ways to review and supervise contractors' operations; policies regarding contractors' fees and cost reimbursement.

Defense Department is participating in this Budget Bureau review. However, Brown, in his recent speech at the Naval Research Laboratory, indicated that Secretary of Defense Robert S. McNamara will make maximum use of available means of raising salaries of military research personnel pending action on the Budget Bureau recommendations.

Brown said McNamara's Oct. 14 directive urging laboratory managers to get as much money as they could for their top personnel was "a start" toward the effort to raise morale. "Morale in many of the most important of the Defense laboratories is bad," Brown said.

"In some of the best laboratories, the disillusionment with the Defense Department and the military services as managers is approaching the critical state. . . . . The senior men in some of our laboratories—civilian and military—have not done as much as they might have to avoid this difficult state."

McNamara directed the services to take "full and complete advantage" of Public Law 313 which raises some salaries to $19,000, compared with the standard $18,500 civil service maximum. He called for "clear lines of technical management" for in-house laboratories, declaring the services should feel free to extend tours of duty of officer-scientists at government laboratories. McNamara said procedures must be established to put principal laboratories more directly under the control of the research secretaries of the services.

While stressing the need for improving in-house laboratories, Brown justified the past use of non-profit laboratories on grounds they: offered the swiftest practical response to urgent needs; provided a detached view; studied the problem across service boundaries; gave the Defense Department "sustained support by a university group; performed jobs Defense Department could not do but which would be 'quite improper' for industrial organizations to perform.".

Studies of in-house laboratories to date, Brown said, show "that leadership is the essential point. . . . . The matter of acquiring and retaining leading scientists has become of paramount importance. . . . . Many of the best and most promising men are leaving and very few are being brought in to fill senior positions from industrial and university laboratories." He said shortcomings of many Defense laboratories include poor management; salaries far below industry's; inferior environment, both psychological and physical.

"Action must be taken, and quickly," Brown said. "If it is not, the laboratories will not dramatically go out of existence. They will continue to do some sort of job. There will be fewer and fewer peaks of talent and more and more mediocrity. . . . . We must retain our talented people and we must get new blood from industry and universities."

Exactly what the Kennedy Administration will propose to solve this laboratory problem is still under discussion. But it appears certain President Kennedy, with the backing of many influential members of Congress, will press for higher federal pay for scientific personnel so in-house laboratories can assume a larger and more direct role in military planning. This drive will be accompanied by an effort to readjust government relationships with outside research organizations to disengage them further from military decision making processes.

Umbaugh Moving U-18 Plant to Florida

Umbaugh Aircraft Corp. has leased Bartow Airport Industrial Center, Fla., a 1,750-acre former Air Force installation, as a production facility for Umbaugh U-18.

An 18-month lease was signed last week by Umbaugh with the city of Bartow. Umbaugh announced that employes, tooling, aircraft and other equipment of the company would be moved from Hagerstown, Md., where developmental work has been carried on at Fairchild Stratos Corp. facilities. The U-18 received a Federal Aviation Agency type certificate Sept. 11 (AW Sept. 18, p. 37).

Under terms of the lease, Umbaugh will operate the public airport and will use five structures at the field. The company will conduct research and development work on new models, flight test and training, some component fabrication and final assembly of the U-18s. Lease contains a 23½-yr. renewal option. Rent will be $1,700 per month for the first 18 months and $3,500 per month thereafter.

In announcing the lease, the company said that the first gyroplanes are expected to roll off the assembly line in 90 days. Umbaugh said it still plans to manufacture 10,000 units during the first year of production "through automotive-type tooling and assembly." The plant eventually will employ 3,000 persons, according to Umbaugh.

Discoverer XXXIII Fails to Achieve Orbit

Los Angeles—Air Force Systems Command's Discoverer XXXIII satellite, successfully launched last week from Vandenberg AFB, Calif., failed to achieve orbit as the result of premature shutdown of the Agena B upper stage, following its ignition. The Agena B presumably burned up as it re-entered the atmosphere.

No details of payload experiments were released in keeping with the practice of withholding this information until successful orbit, but Discoverer XXXIII probably contained substantially the same experiments as its predecessor, Discoverer XXXII, which successfully achieved orbit. Discoverer XXXII experiments included equipment to determine effects of exposure to space radiation of samples of metals, experiments to determine effectiveness of various materials as shielding against space radiation, variations in radio propagation through the ionosphere and genetic effects of radiation on seed corn samples.

NATO Is Hoping to Meet V/STOL Deadline Despite German Demands

By Cecil Brownlow

Paris—North Atlantic Treaty Organization officials are still hopeful of meeting the current Dec. 31 deadline for submission of industry proposals in the NATO V/STOL strike-reconnaissance fighter competition despite a new West German bid for modification of the basic specifications (AW Oct. 23, p. 25).

"Things are a little bit disjointed right now," an official of the NATO planning section admitted last week, "but I still think we can get it back in line. . . . I'm not unduly worried yet."

Basically, officials hope to persuade the Germans not to push their insistence that specifications be changed to boost minimum on-the-deck performance and incorporate a need for a high-altitude intercept capability—requirements that might necessitate two separate types of aircraft rather than the one now envisioned under basic NATO military requirement (BMBR) 3. At present, BMBR 3 calls for an aircraft with the capability of flying at a minimum speed of Mach .92 for a distance of at least 250 mi. A covering letter from the NATO secretariat stipulates that any added performance above and beyond this will be taken into consideration. The new German proposals have not yet been laid officially before the secretariat section involved.

Seriousness of the West German stand and the reasons behind it will be thrashed out in subsequent Paris NATO meetings on several levels—technical, military and political. For the moment, there apparently is little outside support for the new plan which would almost certainly bring about a delay in the over-all program.

Deadline Problems

If the present deadline can be met, the aircraft section of the NATO secretariat's production and logistics division has a target goal of deciding upon final design for prototype production within the following six months.

"We know international cooperation is a time consuming process, and we are trying to gain as much time as possible," a section official said.

Although there has been some industry speculation that possibly more than one proposal might be designated for prototype production, primarily because of the national-level political battles for recognition being waged in several quarters, a secretariat official says that there is little possibility of this within a NATO program, although he admits there is always the possibility of one nation deciding to go off on its own.

The same applies to the V/STOL medium-range transport under BMBR 4 for which proposed design studies must be submitted to NATO through national channels by Nov. 15. Here, however, the initial task is to determine what is available and feasible as well as the requirements of interested member nations rather than a direct move toward prototype production.

Five designs reportedly may be selected for further study and development before one particular aircraft is chosen for actual production by the V/STOL transport NATO working group.

Selection of a specific design under BMBR 3 and 4 must first be unanimously approved by their respective working groups, then by the NATO armaments committee and, finally, by the NATO Council. It is hoped that both strike fighter and its supporting transport can be available for operational use by the late 1960s, and at least one competitor says its BMBR 3 aircraft could be ready for squadron service by 1967 if a go-ahead is received by early next year.

Control and Authority

Lines of control and authority have been established along the general lines of those set up for the NATO-sponsored Atlantic turboprop anti-submarine warfare aircraft now being manufactured in France, West Germany, Belgium and The Netherlands. France's Breguet, the prime contractor, is in charge of final assembly and flight testing.

Once the technical characteristics were established within the NATO secretariat, they were transmitted to individual firms of the member nations through national channels, and the names of firms to be contacted were supplied by the respective NATO national delegations. Queries for additional information also must be transmitted through the respective national delegations and, to avoid any possible charges of favoritism, telephoned inquiries on procedural matters to secretariat members are referred back to national authorities. They will, however, discuss questions of a general nature pertaining to the program.

During the heat of the Atlantic competition, some industry representatives complained that the secretariat withheld the requirements from American firms until it was too late to submit serious bids (AW July 28, 1958, p. 18). Secretariat officials, however, say the delay was due to the fact that the U. S. delegation initially failed to submit a list of contractors to be informed, apparently under the assumption that no American firms were interested.

Such a list was finally submitted after individual companies had contacted the U. S. delegation, but by this time the deadline for bids was fast approaching.

Although it had been under consideration by the military authorities for some time before, the V/STOL strike reconnaissance fighter was first considered by the armaments committee in the summer of 1960, approved and then turned over to a working group for the determination of final specifications. These were made available to the industry in June of this year.

When the projects return to the armaments committee the delegates will be expected to state the quantities of aircraft their respective countries intend to order.

In the rush of American firms to gain working agreements for the fighter or transport with European counterparts that are technologically capable and politically potent, some of the late comers have been hard pressed to find suitable firms that have not been tied down by previous commitments. While such agreements undoubtedly will play a possibly major role in the political considerations surrounding the over-all acceptability of a design, a secretariat spokesman said firm ties are not a necessary pre-requisite at the present stage.

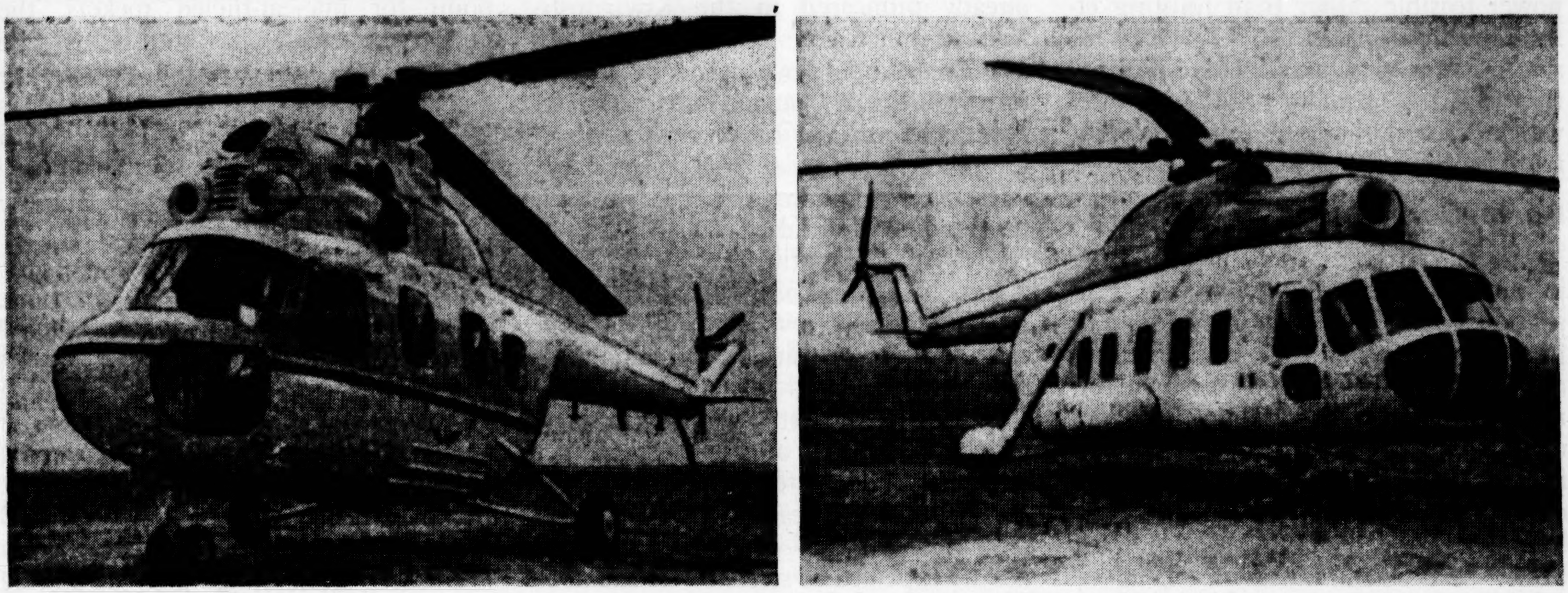
Consortium production is, however, and all firms must state their willingness to work with companies in other nations on a partnership basis if their proposals should be chosen. When the competition narrows to two-to-three potential prime contractors, each will be called upon to submit a detailed production program based upon a consortium arrangement, including the names of European partners.

Aerojet Signs Lease For Additional Land

Aerojet-General Corp. has leased from the State of Florida a 25,313 acre tract adjoining the 50,000 acre tract leased from private owners in Dade county, near Homestead, last month.

Under terms of the 10-year lease from the state, Aerojet will pay $63,000 per year and must begin improvements within a year or forfeit the property. The lease included an option to buy the property outright for $1,265,000.

Aerojet has not announced use to which the land is to be put, but has for some time been seeking property on which to build a manufacturing site for large segmented solid boosters (AW Sept. 4, p. 29) and for manufacturing and testing large liquid propellant boosters.



Russia Unveils New Mil Turbine-Powered Helicopters

Russia has unveiled two helicopters designed by M. L. Mil for commercial passenger operations (AW Oct. 23, p. 30). The V-2 (left), which resembles the piston-powered Mi-1 in fuselage configuration, can accommodate six to eight passengers. The V-8 (right), will seat 20-26 passengers in a cabin radically different from previous Mil designs. Soviet reports indicate that the V-2 and V-8 are faster and more economical than the Mi-1 and Mi-4 series. Payload-gross weight ratio has been sharply increased in Mil's "second generation" craft. Mil indicated early in 1958 that he was planning to replace piston engines with gas turbines in his future helicopter models. Referring to the Mi-1, he declared: "A gas turbine, being smaller in size, could be installed over the passenger cabin, thus enabling us to employ usefully the entire fuselage, which could then accommodate seven passenger seats." Both the Mil V-2 and V-8 have been placed on public exhibition in Moscow.

Seaborg Supports Use of Spur For Electrical Space Propulsion

By Russell Hawkes

Las Vegas—Dr. Glenn T. Seaborg, chairman of the Atomic Energy Commission, told the Symposium on Aerospace Nuclear Propulsion here that the Snap (Systems for Nuclear Auxiliary Power) space power systems are inadequate for more than a test of nuclear-electric propulsion systems and described the USAF Spur (Space Power Unit Reactor) project as the source of an auxiliary power unit which should make electric propulsion practical in space.

It was the first time that an AEC official has announced the commission's support of the Spur program publicly and he implied that he will ask for sharply increased funding of the program. After describing auxiliary power needs of the space program, Seaborg said:

"What must be done by the AEC is a starting point. It appears that the limit of the present technology incorporated in the Snap series of reactors —which is sodium-potassium cooled and uranium-zirconium-hydride fueled – is approximately 150 kw. of useful electrical energy. But there is a need for much more power than 150 kw. Larger energy sources mean the development of a new reactor system; this, in turn means the development of a new technology.

"These future high power systems will require operating temperatures much higher than any currently being developed. Present systems are limited by a family of materials which produces a maximum turbine working fluid temperature of 1,300F and it weighs, at best, 35 or 40 lbs. per kilowatt in sizes up to 100 kw. Typically, a one-megawatt electric plant based on this family of materials would have an extremely large radiator. The surface of this radiator would be about 17,000 sq. ft. The weight and size of this unit alone forces us to look for better systems.

"Better systems require higher operating temperatures for the reactor and its components. Higher radiator temperatures of around 1,500F will reduce the area of this component to something like 2,000 sq. ft. and the unit will weigh about 10 lb. per kilowatt.

"Only expanded research can give us the boiling liquid metals, light-weight shielding, more efficient heat transfer, high-temperature nuclear fuel and new structural materials we must have for future high-power, low-specific weight systems.

"The reactor will probably be lithium-cooled. The fuel will probably be uranium carbide or some other high temperature fuel material. The reactor as a whole will probably operate in the fast region rather than in the thermal region." An AEC scientist commented that this is a rough description of USAF's Spur.

Seaborg also called for accelerated development of nuclear thermionic power systems in the megawatt range. He said the two main problem areas in the development of the systems are the invention of high temperature fuel elements and the development of the basic method of thermionic conversion. Reactor temperatures for a thermionic system must approach 3,500F to get good electron emission characteristics.

Aerojet-General Nucleonics Division is reported to have proposed to USAF a thermionic generator which would use a reactor similar to that of Spur. The system would have a liquid lithium heat transfer loop with the thermionic elements grouped around the radiator. Elimination of the Spur rotating machinery and the two-stage lithium-potassium heat exchanger is expected to result in the lithium working fluid reaching the radiator at a temperature which will approximate that needed for efficient thermionic power conversion. A secondary benefit of this concept is that the surrounding thermionic cells tend to solve the important problem of radiator protection against micrometeorite strikes. A single hit on an unprotected radiator could cause a complete loss of the system while a single hit on the thermionic shell could do no more than reduce the system capacity by the output of one thermionic cell.

Dr. Seaborg said that the policy of the AEC in its space power system development program is to seek the largest power feasible rather than limiting efforts to an arbitrary power level. He said this policy is based on the assumption that the ultimate needs for power will be greater than any forseen in current planning estimates.

Nerva Contracts

Lt. Col. Howard R. Schmidt of the joint AEC-NASA Space Nuclear Propulsion Office told the first session of the symposium that Nerva contracts already include one to formulate a PERT management system for the development team and others to prepare test installations in the big nuclear rocket development center now being established near the Project Rover complex in the AEC Nevada test site.

The first new element of NRDC will be test cell No. 1 for Nerva which is now under construction. It will be the first downward-firing test stand for a nuclear engine and will have the flame bucket and some of the other familiar characteristics of chemical rocket test stands. Engines to be tested will be moved from the maintenance, assembly, and disassembly building to the test stand by a remotely controlled locomotive using remote handling techniques already pioneered in the Kiwi tests. When the engine has been coupled and checked out, two halves of a cylindrical shield are moved into place by remote commands to prevent neutron activation of the test cell structure. After a test the engine will be taken to the MAD building by the remote controlled locomotive. The cylindrical radiation shield also provides a chamber which is partially evacuated by a steam ejector pump to simulate a high altitude environment.

Three more test stands not yet started will be needed for all the engine static tests and engine integration tests in the Nerva and Rift (Reactor in Flight Test) programs. NRDC construction activities are expected to stretch over the next three or four years and are to be on such a large scale that a construction management company will be chosen for the project.

Schmidt said a stage development contract for the Rift vehicle will be let in early 1962. All of the four contractors who have studied the problem of flight testing Rift have recommended that the mission profile be a ballistic lob shot from Cape Canaveral with a Saturn Booster.

AEC Plans Launch Vehicle Buy To Study Nuclear Propulsion Hazard

Las Vegas, Nev.—Atomic Energy Commission plans to purchase a number of launch vehicles, possibly including the Scout, Pershing and Thor-Agena B, for a series of tests to explore health hazards and contamination created by possible failures in future space shots employing nuclear propulsion or nuclear auxiliary power devices, the International Symposium on Aerospace Nuclear Propulsion was told here last week.

AEC contemplates a series of experiments, possibly beginning during the Fiscal 1963 period, to simulate the effects of these nuclear vehicles reentering the earth's atmosphere after failure to orbit, re-entering uncontrolled from orbit or ballistic flight and possibly re-entering under control. The commission hopes to gain experience and accumulate knowledge from the initial tests in the series before the flight of the first large Snap reactor.

No Obstacles Seen

This was indicated in a report by Lt. Col. J. A. Connor, Jr., formerly with the division of reactor development of the AEC, and now with National Aeronautics and Space Administration in Washington.

Connor says he does not envision any obstacles arising to prevent use of nuclear devices in aerospace environments. Separately, it was reported at the symposium by an engineer from the Martin Co. that the State Department had not received any adverse world reaction to the orbiting in Midas 4A last summer of the first orbital radioactive device, a radioisotope generator made by Martin.

In a related, parallel series of tests to those planned in space vehicles, the Air Force Special Weapons Center Biophysics Directorate is now conducting for AEC at the National Reactor Test site in Idaho Falls another series of tests to pinpoint any health hazards posed by the use of nuclear devices in vehicles that explode on launch pads or in early phases of powered flight, thereby possibly releasing harmful radioactive material. These tests are being conducted with General Dynamics Corp. as a prime contractor. Air Force and AEC hope to learn what happens to nuclear materials released through destruction and fires. They plan to determine what size particles may be released, their distribution, etc. In the Idaho Falls experiments, small amounts of fissionable materials are burned in crucibles to simulate launch pad disaster situations.

From the results of these tests, AFSWC and AEC hope to determine the exclusion radius from the launch point for nuclear-fueled rockets, the permissable wind characteristics at the time of launch and other factors which may help in specifying safety conditions for men and equipment. The exclusion radius for nuclear-fueled vehicles may be smaller than that for chemically powered systems.

AEC Wants Control

AEC wants its own launch vehicles so that it can have complete control over an entire payload, rather than merely being a piggyback passenger on another shot as it has been in a recent Atlas E series and on Transit 4A.

In the projected vehicle tests, AEC intends to simulate the failure of a vehicle to achieve orbit by returning the vehicle into the earth's atmosphere at speeds between 24,000 and 25,000 fps. and at shallow re-entry angles (about five degrees).

Several areas the commission is exploring and hopes to make safe from harmful side effects of released radioactivity are:

- **Launch.**
- **Destruct capability.**
- **Burning up during re-entry.**
- **Return from orbit** (burnup capability).
- **Ultimately, controlled re-entry.**

In connection with the AEC launch series, the possibility of recovering and reusing the guidance package of a Scout or modified Pershing missile will be investigated.

Studies Planned

Also mentioned at the symposium were plans for:

- **Detailed studies of proton** and electron intensity and spectrum to be made by detectors in NASA's A15 and A16 communications satellites scheduled for launch into low-altitude, 40-deg. inclined orbits next year. These satellites will be targeted as one-year lifetime vehicles.
- **An S-3A satellite shot,** scheduled for launch in mid-1962, at the time of the anticipated demise of Explorer XII, for the purpose of continuing its function of monitoring fluxes in space.
- **Inclusion on Mariner R** (Atlas-Agena B launch vehicle carrying Venus flyby package) of a plasma probe magnetometer and a device for probing energetic particles.
- **Radioisotope thermoelectric** generator using Curium 242 isotope as heat source for electric power supply of the Surveyor unmanned, soft-landed lunar spacecraft. There had been some fear that such a device would cause contamination on the moon, thereby interfering with scientific tests designed to yield information about the origin of matter. Curium 242 is an Alpha emitter only and is not expected to interfere with Beta and Gamma ray inspection of the moon's surface.

Midas Detects Titan

Cape Canaveral—Midas IV infrared sensors picked up the launch of a Titan ICBM development flight minutes after it was launched here at 6:28 p.m. Oct. 24.

The experiment had a 10-min. window in order for Midas to be in sight of the Titan, and the missile was launched during the first minute. Confirmation of the detection was made by the Midas readout station in Sunnyvale, Calif.

The USAF-Martin Titan impacted 6,100 mi. down the Atlantic Missile Range.

Radar Is Seeking West Ford Dipoles

Washington—A radar search was under way late last week for a small patch of metal fibers believed to have been placed in orbit as a piggy-back payload with the USAF's Midas IV ballistic missile defense alarm system satellite, launched from Point Arguello, Calif.

The controversial Project West Ford experiment, conducted by Lincoln Laboratory for the Air Force Systems Command, is intended to produce a belt of tiny dipoles in polar orbit capable of reflecting radio signals at microwave frequencies (8,000 mc.) over intercontinental distances.

Telemetry signals indicated that the 20 x 6 inch cylinder containing 350 million tiny metal fibers was ejected from its canister shortly after the Midas IV went into orbit. If the experiment went according to plan, it was expected to be 30 days before the patch of orbiting dipoles released would spread into an earth circling belt.

Difficulty of locating the patch of dipoles may be due to the fact that radar has never before been used to locate so diffuse a target at such extreme ranges.

After about 60 days the tiny dipoles are supposed to be evenly dispersed about the earth at 1,200 ft. intervals with an average density of about 90 dipoles per cubic mile. An Air Force spokesman said their orbital lifetime will be no more than a few years before the pressure of solar radiation drives them into the atmosphere.

NASA Orders 14 More Deltas From Douglas

Washington—Formal contract calling for delivery of 14 additional Delta vehicles has been awarded to Douglas Aircraft Co. by the National Aeronautics and Space Administration. Amount of the contract is $19 million.

The additional order, disclosed by AVIATION WEEK in June (June 26, p. 32), was due to the reliability demonstrated by the vehicle. Six of the 12 Deltas on the original order have been launched; the last five were successful.

The remaining six vehicles will be used to launch a variety of scientific satellites, and two additional Tiros weather satellites (AW Aug. 28, p. 33). The new Deltas will be used to launch Tiros and communications satellites, including NASA's Relay and Syncom and American Telephone and Telegraph Co.'s Telstar active satellites.

The tenth Delta vehicle has been assigned to carry the United Kingdom electron satellite, designated UK-1, which recently was shifted from a Scout vehicle because the satellite is too large to fit the Scout payload envelope (AW Oct. 9, p. 27).

Delta vehicles delivered under the new order will develop 170,000 lb. thrust using the MB3-II Thor booster propulsion system. The first 12 vehicles use the MB3-I engines, standard in DM-18 Thors, which develop 150,000 lb. thrust.

Because of a shorter transition section, the new Deltas will be 73 ft. high, compared with the 77-ft. vehicles in the first order.

Helicopter Record Claims

Air Force has claimed three new world rate-of-climb records for the Kaman H-43B Huskie turbine powered helicopter. All were made in one flight at the Kaman plant at Bloomfield, Conn. They are:

- **Time-to-climb to 3,000 meters (9,842 ft.), 2 min. 44.5 sec. Previous record of 3 min. 29.1 sec. was set by a Bell HU-1 in July, 1960.**
- **Time-to-climb to 6,000 meters (19,684 ft.), 6 min. 42.3 sec., breaking a record of 8 min. 7.1 sec. set by the HU-1, also in July, 1960.**
- **Time-to-climb to 9,000 meters (29,526 ft.) 14 min. 11.5 sec. Previous record was held by a French Alouette with a time of 17 min. 43.9 sec. set in June, 1958.**

Russian claims received by the Federation Aeronautique Internationale in Paris last week contain slightly different figures for records set by the Kamov Vintokryl convertiplane than those that appeared in the Russian press (AW Oct. 23, p. 30).

Over the 15-25 km. course the claimed figure is 366 kph. (227.4 mph.) and over the 100 km. closed course, 336 kph. (208.8 mph.).

The recent Soviet claim that its E-166 fighter set a world speed record over a 100 km. closed course of 1,482.039 mph. would, if approved, better the old record of 1,390.24 mph. set by Cdr. John F. Davis in a McDonnell F4H-1 in Sept., 1960.

News Digest

Budget Bureau should be given a larger planning role, the Senate Government Operations National Policy Machinery Subcommittee said last week in its sixth and final report. The report said the Defense Department's plan to make budget projections for five-year periods rather than annual estimates was the type of advance planning needed throughout the government.

Liquid-propellant Seabee rocket was fired from the water off Pt. Mugu, Calif., last week in an Aerojet-General program to determine the feasibility of the technique for liquid engines. Rocket was fueled while floating horizontally, ballasted upright and fired from underwater with about four feet of the tip extending above the surface.

Deadline for comments on proposed plan to establish a non-profit company for the development, operation and management of a commercial communication satellite system has been extended from Oct. 30 to Nov. 12 by the Federal Communications Commission (AW Oct. 23, p. 29). The FCC took the action after request for extension by General Telephone & Electronics Corp.

British European Airways will sell its 25% holding in an independent carrier, Jersey Airlines. BEA will first offer the 50,000 shares it holds to Jersey, then try to sell them on the open market if the carrier does not purchase them. BEA has been associated with Jersey since 1956. Earlier this year, BEA sold its holdings in Alitalia, the Italian airline.

Gen. E. W. Rawlings, former commander of USAF Air Materiel Command, has been named president of General Mills, effective Dec. 1. He will succeed Charles Bell, who will become board chairman of the company. Gen. Rawlings, executive vice president of General Mills since April, 1960, retired from the Air Force in 1959. He was commander of AMC from 1951 to retirement.

Breguet 1150 ASW Atlantic made its first flight Oct. 21, at Toulouse, France. Flight lasted 42 min. and went off without difficulty. Twin-turboprop aircraft, powered by Rolls-Royce Tyne engines, carries a crew of 12.

Sigurd Varian, 60, founder of Varian Associates, was killed recently when his Piper Apache twin crashed in a heavy sea off the west coast of Mexico.

AIR TRANSPORT

IATA Plans to Bolster Enforcement Unit

Threat of crackdown by CAB moves convention delegates to seek improved policing of illegal rates.

By L. L. Doty

Sydney, Australia—Fear of governmental interference in the enforcement policies of international airlines has led delegates to the International Air Transport Assn.'s general meeting here to seek to strengthen the Breaches Commission, the group's internal enforcement body.

This action was prompted largely by a letter sent earlier this month to Pan American World Airways President Juan T. Trippe by Civil Aeronautics Board Chairman Alan S. Boyd. The letter, circulated at the opening work session as an agenda item, expressed concern over the "serious adverse effect of unlawful rate and tariff practices by certain foreign carriers operating to and from United States."

Boyd said he understands that these practices were becoming more widespread and warned that "the board is undertaking a strong enforcement program designed to develop proof of such violations. If proved, it is probable that much more severe enforcement steps than heretofore attempted will be pursued."

Boyd urged IATA to accelerate its efforts to police and enforce agreed rates and concluded that cooperative action would "correct a deteriorating situation which has but superficial benefit to the few while creating long range disadvantage for all."

Chief offense has been the practice of allowing or even encouraging travel agents to sell international tickets at discount prices as a means of drawing traffic away from competition. This has been particularly prevalent in New York, according to delegates.

London Airport Charges

London—Minister of Aviation Peter Thorneycroft last week declined to comment on Sir William Hildred's accusation that he refused to listen to arguments in favor of reducing London Airport charges.

In another round in the running battle between the two, Sir William claimed Thorneycroft has applauded IATA's policy of trying to produce low fares and then proceeded to make it impossible by raising his charges by $5.6 million. "Go away and do the impossible," he said.

Thorneycroft's position is that airlines will be charged for the use of air traffic control, navigation and meteorological aids (AW Aug. 14, p. 41) to eliminate taxpayer subsidy. His philosophy probably will be debated soon in Parliament.

Referring to the increase in charges, the Ministry contends the figure for 1961 will be $3.5 million, compared with the figure used by Sir William.

Cash Under Table

Payment of cash bonuses to minor employes of travel agents is another method allegedly used as means of luring business. Some carriers are said to be collecting only 70% of the total fare charged the passenger by the travel agent as one means of allowing under-the-table discounts.

Generally, it is conceded that violations are committed at the local sales level and that top-level managements are continually battling to curtail them. One carrier, Avianca, considers proof of such acts as reason for immediate dismissal of a guilty employe.

In the past, IATA has taken only lukewarm measures to bolster its enforcement policy. An attempt last year to increase the maximum fine failed on the grounds that, of 691 cases brought before the Breaches Commission, only eight resulted in a maximum penalty. Prior to this week's meeting, a mail vote was taken among members to determine whether the rules should be changed to hold travel agents rather than airlines directly responsible and thus subject to fines for participating in rate cutting. Because of ill effects this proposal may have on airline-travel agent relations it is not expected to pass.

Here are measures IATA hopes to adopt as first steps toward strengthening enforcement rules:

- **Increase the number** of enforcement officers from 24 to 36.
- **Use police methods** in uncovering violations and adopt task force system in monitoring industry.
- **Authorize free endorsement** of tickets from one airline to another. In such cases an airline receiving a passenger from another airline through an endorsed ticket is not likely to accept such a ticket if it must absorb an unauthorized discount in the process.
- **Minor breaches** would be disposed of summarily without detailed investigation to allow more time for handling major infractions.
- **Although maximum fines** would remain at present level, intermediate fines would be increased.

Proposed adoption of the principle that violators are guilty until proved otherwise stood little chance of approval because of opposition of British and American carriers.

In general, the tone of this meeting was one of apathy, with most delegates appearing to be more engrossed in their own economic problems than in problems of industry or IATA. Twenty-two airline members were not represented, including Eastern, Varig (Brazil), Northwest, Real (Brazil), Trans-Canada, Cunard Eagle (Britain) and Aerolineas Argentinas.

Shop talk centered around excessive capacity, fares and the fact that, outside of the blue ribbon North Atlantic market, tourist traffic growth is falling short of expectations. Internal politics was confined to election of officers to fill nine vacancies of the powerful executive committee.

Proponents of Richard Jackson, president of Seaboard World, who was nominated for a post on the committee by his company, conducted a vigorous campaign during the week. Jackson represents liberals within IATA who want

Equal Fares Sought

Sydney, Australia—International carriers are facing a new type of price cutting problem from the growing number of newly independent nations. Airline heads at the general meeting of International Air Transport Assn. here have been asked to petition their governments for regulations requiring the substitution of higher IATA rate levels for the lower fares held under former colonial regimes.

Refusal of some nations to eliminate these fares has created a problem on several international routes, it was charged, and was also one of the chief reasons for the collapse of the last IATA traffic conference at Cannes, France.

New Overhaul Time Plan Is Devised

Miami—U.S. airlines and the Federal Aviation Agency moved closer to agreement last week on a compromise system for controlling engine overhaul time—a plan that tempers FAA's controversial formula approach to the subject.

The new system, which may or may not prove workable, was developed quietly by American, TWA, United and Continental engineers and FAA's Flight Standards Service during meetings that began late last summer. A six-month evaluation probably will begin within two weeks and involves the four carriers that helped conceive the system along with Piedmont, Riddle and possibly West Coast Air Lines.

Engineers attending the annual Air Transport Assn. engineering and maintenance conference here agreed that the compromise, which includes significant concessions on FAA's part, represents "real progress." Next month FAA plans to stage a two-day presentation in Washington, D.C. to brief its regional air carrier inspectors on the system and gain their reactions.

Time between overhaul (TBO) of U.S. airline engines now is controlled by a relatively simple formula that "escalates" TBO up and down according to an individual carrier's absolute engine failure rate during a 90-day period. For almost two years, the airlines have argued that this system is unfair because, they contend, there is no precise relationship between failure rate and overhaul time.

The proposed system establishes a "par value" or index number for every airframe/powerplant combination now in airline use. That index number would express the number of engine shutdowns—not engine failures—versus the number of engine hours recorded. Index numbers, generally, would be derived empirically from the past 18 months of industry experience. Each engine would have a different index number reflecting the degree of reliability built into it.

On the 10th of each month, all airplanes would report to FAA the number of engines they were forced to shut down during the preceding 90 days.

On the 25th of each month, another report would explain each shutdown, informing FAA whether it was precautionary or due to a malfunction.

If an airline's malfunction rate was at or lower than a particular engine's industry-wide index number, that airline usually would be eligible for a TBO extension, assuming it had not been awarded one for a specified time span and it complied with other ground rules of the program. Shutdown rates that exceed engine index numbers would fall into what was described as an "alert area."

According to Al W. Dallas of ATA's engineering department, an alert area shutdown rate would mean an immediate consultation between the operator and the appropriate FAA regional office. A program to reverse the trend toward excess shutting down of the engine at issue then would be developed by the airline and formally analyzed by the FAA, Dallas said. If at this point the two parties deadlocked on what corrective action should be taken, the FAA regional office would appoint a "team of experts" to study and recommend changes in the program, he reported.

Until the airlines can assess the new system, FAA has agreed to hold in abeyance the proposed Civil Aeronautics Board regulation that would make engine failure rate the sole key to TBO extension.

Under the compromise plan, engine shutdown rate would play an important part in fixing the size of the TBO increase awarded. But FAA also would consider the size of the airline, its experience with the particular engine, its maintenance know-how, its facilities and the reason underlying each shutdown it reported.

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stronger representation of smaller carriers as a first step toward breaking dominance traditionally held by Pan Am, British Overseas Airways Corp., KLM (Royal Dutch Airline) and Air France. In his platform, Jackson admitted the importance of retaining these larger carriers in top IATA positions because of significant financial and manpower contributions, but called for committee makeup that would ensure representation of all major geographic areas.

American Dominance

Jackson's bid failed by a narrow margin due to fear of American dominance of the executive committee. Although the incumbent committee members retained their strength by electing their own slate, Jackson gained his primary goal in the campaign—a more democratic process in the election of committee members through the introduction of a secret ballot for the first time in IATA history.

This achievement gives the liberal group new opportunity to gain more recognition at future meetings.

In a private session before the general meeting opened, the executive committee had considered several means of staving off a secret ballot, but none was adopted.

The dwindling prestige of IATA drew some attention, but no conclusions had been reached as of late last week. One suggestion was made that the general meeting should attempt to devote more attention to guidance of committees and conferences, particularly the traffic conference.

On this, V. H. L. Dubourcq of KLM, who was chairman of last year's traffic conference in Cannes, assured IATA delegates that it would "be a long time, if ever" before he would again accept the task of attempting to get IATA members to agree or even compromise on an acceptable rate structure.

An-10 Modification

Moscow—Soviet An-10 transport is being modified to carry 132 passengers compared with current maximum passenger configuration of 100, according to Soviet aircraft designer O. K. Antonov. He attributed the increased capacity to changes in the interior seating configuration.

Antonov also said that "we are working on problems of installing television sets and cinema apparatus in all production models of An-10 aircraft." He again repeated past promises that the An-24 transport would soon enter passenger service, but did not give any specific date for inauguration of its service.

Early in the general meeting, several attempts were made to persuade Dubourcq to modify his report, a cutting criticism of the tactics applied by larger carriers in deadlocking traffic conferences in their own interests. The report charged the large carriers with being the most "ruthless blackmailers of conference time" by sidetracking floor discussions on major issues with minor matters.

Constant Threat

Dubourcq said in his report, as originally written, that an "art of brinksmanship" has been created by the constant threat of throwing the industry into an open-rate situation. He deplored the growing use of such a threat to gain a point in traffic conference negotiations and added:

"By now, companies' positions on the more important issues are known fairly well and this sort of gambit does not fool anyone, but yet it consumes a lot of time—the more so, since it leads everyone to follow the same tactic but perhaps one point further removed from their real position. And one day, someone will over-reach and it will be the end."

AMERICAN
NEW YORK Airways
BOEING-VERTOL 107
ERICAN AIRLIN

IDLEWILD site of New York Airways' operation is American Airlines' individual terminal at the airport. Above, the 107 parks near American jet. Gate position in the helicopter operation is further from jet gate, with about 30 ft. between rotor blade tip and jet wing.

N.Y. Airways 107 Fleet Keyed to Subsidy

By Glenn Garrison

New York—New York Airways' plans for converting to a turbine-powered Boeing-Vertol 107 helicopter fleet, with service beginning early next year, are in an uncertain state in view of the current helicopter subsidy situation.

Since Civil Aeronautics Board recently indicated it may not approve New York Airways' guaranteed loan application covering five aircraft, the carrier may be forced to accept only four ships under the loan and look around for financing for the fifth if traffic warrants.

Ceiling on Subsidy

New York Airways' difficulties arise from congressional action last summer putting a ceiling on the subsidy available to New York Airways, Chicago Helicopter Airways and Los Angeles Airways, and on CAB indication this month that the $6 million available for subsidy in Fiscal 1962 would be split evenly among the three carriers. New York Airways has been receiving almost half the total awarded to the three helicopter lines.

The New York carrier's original turbine transition plans called for a five-ship initial operation with a subsidy of $3.4 million for the first full year of turbine operation. Plans also called for extension of routes.

However, all three carriers were asked by CAB to submit new plans based on several subsidy allowances. New York Airways' plans for both a five-aircraft and a four-aircraft operation topped the $2-million figure. CAB then advised the carriers that loan applications of Los Angeles and Chicago covering four aircraft each would be approved promptly, but that "prior to any action by the Board on NYA's pending loan application, the Board is affording this carrier a further opportunity to submit a plan or plans for operating four V-107s within the $1,950,000 limitation." (The $6 million drops to $1,950,000 in Fiscal 1963 or such earlier date when turbine equipment is fully integrated, and the rate in succeeding years will be reduced by $50,000 per year.)

The Board recognized that certain services of all three carriers would have to be cut to operate within the subsidy ceiling. Chicago, according to CAB, is expected to discontinue its mail service with Bell aircraft; Los Angeles will partially curtail its proposed route expansion.

Five-Ship Operation

New York Airways, however, considers a five-ship operation the minimum that would meet the needs of its area. Its recent revised proposal to the Board concerning a five-ship plan supposed a first-year subsidy of $2,752,000, and the elimination of some existing services and some proposed expansions. It described this plan as the minimum "to which serious consideration should be given."

To cut Fiscal 1962 requirements before the introduction of turbine equipment, New York Airways—at CAB's suggestion—has filed for temporary suspension of some services now operated. But, hoping for a change in the situation before the turbine patterns are established, the airline asked for the suspension only until Feb. 1 of next year.

New York Airways President Robert L. Cummings, Jr., regards the subsidy situation as "extremely serious" but believes the evenly divided $6-million position of CAB is a tentative one and is hopeful it will be modified. He has described the plan as being "much like the celebrated judgment of Solomon." If New York Airways can't win a modification of the plan, Cummings says, its future plans are unclear. He considers the $2-million limit "plainly inadequate" and five aircraft the minimum required in the interests of proper development. The program outlined by the Board, he feels, "would require the contraction of the New York operation to an airport shuttle service only."

New York Airways officials believe the airline has been unjustly criticized as a high-cost operator. Cummings says he is constantly confronted with the question "if you can do it for X number of dollars in Los Angeles or Chicago, why can't you do it in New York?"

Singular Difficulties

But the New York carrier's situation, he feels, is unique in several respects. Here are the factors as defined by New York Airways:

- **Weather** in the New York area is worse than in the Chicago or Los Angeles areas. The airline has made a careful study of the weather situation and it is worse "in all categories" in the New York area, often varying among the three major airports served by New York Airways. The carrier has expended considerable effort in attempting to pioneer new instrumentation which will permit IFR operation.
- **Expenses** of an unusual nature in providing service. For example, the unit

terminal situation at Idlewild means operation by New York Airways of buses to provide connections for its passengers. Also, the carrier has four major points to serve.

- **Financing** on a sound basis which has produced a current ratio with Vertol 44B piston equipment of 88 equity dollars to 12 debt dollars. This will go to 43 equity against 57 debt with the initial 107 operation. Cummings said the even split would penalize New York Airways and the communities it serves "principally because our company has successfully carried out the very capital financing program which the Board has applauded as a good example for the industry."

The weather situation, according to the airline, has resulted in a performance factor percentage for New York Airways generally in the high 70s (this year's will be about 80) compared with the high 80s and low 90s for Los Angeles and the 90s for Chicago. Thus two out of every 10 of New York Airways' customers cannot be properly served and cancellations mean the expense of backup service and interrupted trip expenses, plus loss of good will.

Various programs such as studies of instrumentation, noise and factors in operating from city rooftops, have advanced the state of helicopter operation, Cummings says, but New York Airways is often criticized for the cost of such programs. It is mostly a matter of time and effort, however, Cummings said, because the cost hasn't amounted to more than $75,000-80,000 a year at the most.

Transition from the single-engine 44Bs to the twin-turbine 107 will permit New York Airways to:

- **End restrictions** at several points on its routes. For example, night passenger operations in and out of Manhattan will be possible for the first time.
- **Speed service** between the points both because of the higher cruise speed of the aircraft and the fact that many routes can become direct. Single-engine limitations now require several circuitous routings.
- **Boost passenger traffic** from an estimated 150,000 this year to an estimated 400,000 during the first year of turbine service.
- **Serve new rooftop heliports** such as the planned Pan Am Building heliport in mid-Manhattan and the planned New York World's Fair heliport atop a restaurant. The vertical takeoff and landing characteristics of the tandem rotor 107 are vital to these plans.
- **Advance New York Airways' goal** of IFR operation to overcome the weather problem. Even with the 107, performance factor under present VFR limitations is estimated at only 85%.
- **Reduce minimum altitudes** and permit straightening of routes. At present, operations must be conducted over open areas. Minimum altitudes over Central Park are 1,200 to 1,500 ft.; minimum altitudes with the 107 are not expected to exceed 500-700 ft. anywhere in the pattern.

Helicopter IFR System

Washington—Federal Aviation Agency has set a Jan. 1, 1963 target date for inaugurating operation of an Instrument Flight Rule system for helicopters, according to Harry Bernard of FAA's Flight Standards Service.

The Agency, Bernard said, also is considering a rule that would allow helicopter operators to hoist and carry external loads without obtaining special FAA certificates. Such operations could be conducted for compensation under the proposed rule, he said.

Because the helicopter is a "very fine radar target," Bernard said, FAA efforts to establish control and separation by use of radar have achieved "considerable success" in Chicago and Los Angeles.

New York Airways' present pattern of service, with a fleet of five 44Bs, involves 26 daily round trips in its shuttle operation between Idlewild, La Guardia and Newark airports and the downtown Manhattan heliport at Wall St. This is now operated with three 44Bs, but two 107s are expected to do the job.

Suburban services include three passenger and one cargo-mail round trip at Stamford, Conn.; three passenger round trips to White Plains, N.Y.; an all-cargo round trip to the airport at Bridgeport, Conn.; and one round trip to Teterboro Airport, N.J., which carries passengers one way and cargo the other.

Sample times are 23 min. Idlewild-Newark, which will be shaved to 13 min. with the 107; 11 min. Idlewild-La Guardia, which will go to 6 min.; La Guardia-Wall St. 10 min., which will go to 6 min. Because of the circuitous routing necessary (via La Guardia or via Coney Island), there is now no direct service between Idlewild and Wall St.; the 107 will make such service possible with a time of 7 min.

The northbound suburban routes are now served from La Guardia, but again the 107 will make it possible to shift this connecting point to Idlewild.

The application for suspension of services noted above involves Bridgeport, Stamford, White Plains, Teterboro and the night mail service now being operated to the W. 30th St. heliport in Manhattan. This service operates from Idlewild and La Guardia to 30th St., then on to Newark. It runs all night, handling 4,000-5,000 lb. of mail as well as about 1,200 lb. of express and some freight.

The original plan for 107 service called for expansion to Danbury and New Haven, Conn., passenger service to Bridgeport's now idle heliport, service to Paterson, N.J., and service to Rockville Centre on Long Island. Also planned was greatly expanded service to Teterboro, Stamford, and White Plains, service to Manhattan after dark, and a general increase in service.

Under the revised plan for five aircraft submitted last month to CAB, all service at White Plains, Danbury, Rockville Centre and W. 30th St. is eliminated, and other suburban operations are limited. It calls for 34 round trips daily in the inter-airport and Wall St. shuttle, with average 30 min. frequency. Six round trips are scheduled to Stamford, Bridgeport and New Haven, and six to Teterboro and Paterson in New Jersey.

For the first full year of operation, this plan estimates total non-subsidy revenue at $3,228,000. Total subsidy need is set at $2,752,000. This includes $1,027,000 allowance for return and taxes, on a 10-year average basis. By averaging the return, New York Airways says about $400,000 in subsidy was eliminated.

Scheduled miles total 985,000 with a performance factor of 85%. Average utilization is 4 hr. 20 min. Revenue passengers total 408,000 with a 42% passenger load factor. Available seat miles total 20,375,000; average trip distance is 21 mi. Yield per passenger mile is 36 cents.

The plan calls for two aircraft fully scheduled in inter-airport and Manhattan service; one aircraft in suburban service; one in training, route check and fleet backup use, and one in maintenance.

New York Airways said the five aircraft are barely sufficient to meet further requirements, particularly the need for protection against irregular schedule performance.

The carrier has an option on five additional 107s, with plans to take deliveries as traffic warranted. When the fleet reaches a total of seven, it had been expected that breakeven subsidy need would drop to zero. If service is inaugurated with fewer than five aircraft, the carrier says this result will be postponed.

While the revised plan above is described as the minimum which should be seriously considered, New York Airways also provided plans for four- and three-aircraft operation. Lowest subsidy need was $2,002,000 for three aircraft in inter-airport service only, carrying 298,000 passengers and with a utilization of 4 hr. 18 min.

The rooftop heliports offer "fantastic possibilities," according to New York Airways officials, and are bound to accelerate the delivery of more aircraft. The fair, scheduled to be held in 1964-65, is expected to require three aircraft in continuous service between the fair site, the Pan Am roof and the Wall St. site. In addition, the airport shuttle will serve the fair on a scheduled basis. Leased aircraft would be a possibility to handle the fair traffic. The fair is expected to bring a traffic peak, and the airline will try to build service so that the peak won't drop off after the fair.

The Pan Am Building roof is expected to be in operation in 1963. Negotiations are still under way between Pan Am, the building corporation, and New York Airways (AW Oct. 2, p. 42).

Both the fair and the Pan Am Building roof offer rich potential in two-way traffic flow, New York Airways officials say. Fair visitors will be coming and going in shifts. As far as the Pan Am roof is concerned, surveys indicate that about 50% of the people coming into the New York airports have an ultimate destination in the midtown area where the building will be located. Arrivals from the airports should balance office executives leaving the area.

Noise Tests

Rooftop operation suitability is a part of the noise test program that has been carried out with the production 107 now being used by New York Airways. In one recent test, the aircraft went through hovering, vertical climb and descent and ground idling exercises at La Guardia, while noise technicians made measurements in the airport manager's office. This was to simulate what office workers in midtown Manhattan near the Pan Am Building would hear. Vertol retained an acoustical consultant company to make the tests.

The airline's contract with Vertol spells out internal and external noise criteria which must be met, and New York Airways says the 107 is meeting these requirements. They call for a maximum external noise of 86 ± 5 db. measured 100 ft. horizontally from the helicopter in hover attitude. Internally, the maximums are 86 db. in the cockpit and 73 db. in the cabin.

New York Airways plans to utilize fully the vertical climb and descent characteristics of the aircraft. Approved operation is expected with no height-velocity curve for the 107 under standard conditions up to the maximum gross weight of 18,650 lb. Pilot proficiency is expected to eliminate the curve under non-standard conditions.

New York Airways has put about 100 hr. on its current 107, which will go back to Vertol for modifications including the upper control system fix. The aircraft actually is the third production model, the first being retained by Vertol and the second—which is New York Airways' No. 1—now in FAA testing along with several others.

Vertol has stationed a half dozen engineers and 10 mechanics at New York Airways' La Guardia headquarters to work directly on de-bugging problems with the aircraft. Modification drawings are issued on the spot. About 150 items, none of them serious, have turned up, including such work as radio re-wiring, maintenance accessibility changes and the like.

Harco to Be Evaluated

London — Eurocontrol, the integrated international air traffic control system above 20,000 ft., will evaluate a navigation system called Harco (hyperbolic area coverage) developed jointly by Decca Navigator Co., C.S.F. of France, and Telefunken of Germany.

System will include an improved Decca system which eliminates distortion on the pilot's presentation, one of its major criticisms in the Decca-VOR/DMET controversy. Follow-on to Decca is called Omnitrack and is currently being flight tested. Prototype unit has flown about 1,200 hr.

Working with three developers will be Teleregister Corp., which specializes in on-line data processing and systems design. Evaluation of the Harco system will start early next year. VOR/DMET system also has been submitted for Eurocontrol approval.

The aircraft was grounded once because of a problem in the short high-speed shaft connecting the mixing box and the engines. In effect, the design fix was to change to larger bolts and rework the threads between nut and bolt to tighten the fit of the shaft and reduce vibration.

Other problems have included oversensitivity in the yaw sensing part of the stability augmentation system. The system in the prototype worked perfectly, but it was hand-built. The more sophisticated, lighter production system still has sensitivity problems, but they are being solved.

The 107 has a low level of cabin noise, but presently is subject to some noise from blade slap. Use of automatic rather than manual trim control will correct this to some extent, it is expected. Also in process is redesign of blade tips which will alleviate the slap. Another item is the rotor brake, which has been removed temporarily from the present ship. There had been slippage of the brake and modifications are in process.

The airline has been checking out the 107 over its routes, training supervisory pilots, and using the 107 for various demonstrations. These include flying the points involved in the Washington area helicopter case now before CAB, in which New York Airways is one of eight applicants (AW Oct. 23, p. 36).

Line pilots are expected to make the transition to the 107 in about 12 hr. The vertical climb and descent operation is not expected to present a training problem.

New York Airways has applied for a waiver to the requirement that hostesses be carried on transports with capacity of 20 passengers or more, contending that hostesses would have nothing to do on the shorter flight legs. On longer segments, their presence might be justified.

Federal Aviation Agency certification tests with other 107 aircraft are now in progress, and certification is expected not later than the Nov. 25 date which was the most recent target.

New York Airways plans to institute an entirely new maintenance program with the 107. This is a continuous maintenance program based on a 500-hr. cycle, broken down into five phases. Object is to achieve a program of equalized inspection as far as time and man hours are concerned. Goal is never to have a ship down for more than 8 hr. The present 44Bs are down as long as 48 hr. in some cases.

Under the program, the airline's target is 1,000 hr. TBO (time between overhaul) on major components such as main rotor transmissions, and 2,000 hr. on the rotor hub. This assumes a five-ship fleet and will be based on a sampling program. A minimum of one year is expected to be necessary to reach these goals. The airline has expended considerable time and effort in developing its own maintenance program for the new aircraft and expects it to be a milestone.

With the 44B, the main transmission is up to 800 hr. and the rotor hub to 1,600 hr. The figures could be higher, but the airline expected its new aircraft much sooner and did not apply for higher TBOs with the old ships.

Maintenance and overhaul hours with the 44B run about nine man-hours per flight hour and the airline estimates the 107 may reach this level after two years of operation. This of course would be a major improvement, because the 107 is a larger aircraft with more sophisticated systems and a passenger payload of 25 instead of 15.

Maintenance accessibility of the 107 over the 44B is described as a major improvement. One advantage cited is the location of fuel tanks and many electrical components in the landing gear/fuel stubs.

Overhaul of engines is performed by the manufacturer and this will continue to be true with the 107.

The airline originally had planned on receiving its initial 107s with the General Electric T58-100 engines and later retrofitting the more powerful -110s. However, due to the delay in the certification program which postponed deliveries, the initial aircraft now will have the later engine.

New Helicopter Airline Has Early Success

San Francisco—San Francisco & Oakland Helicopter Airlines, operating 68 flights daily with two Sikorsky S-62 helicopters only five months after inaugurating scheduled service, now sees its way clear for a subsidy-free operation.

The subsidy-free formula is based on a high aircraft utilization over very short-haul routes into heavy passenger density areas at a high rate per passenger mile. The airline has contracted with Sikorsky for delivery in January of a third S-62 under a lease-purchase contract, the same arrangement under which the first two were obtained.

Company officials feel the third aircraft will strengthen the formula into a working reality. So far, the company has been unable to show a profit but, since all elements of the formula are particularly adaptable to the area SFO serves, the airline expects to pass its break-even point within a year.

Conducting its service as an air-taxi operator, SFO now serves five points in the San Francisco Bay area: San Francisco airport, downtown San Francisco, Oakland airport, downtown Oakland and downtown Berkeley, the last being a new service launched earlier this month. With the third helicopter, the airline will expand its routes to include Palo Alto.

Subsidy-Free Formula

Here are the details of the philosophy which SFO feels will help it reach a self-sustaining performance:

- **Break-even load** factor on the 750 seats now offered daily is about 38%. Currently, the airline is carrying an average of about 150 passengers each day. Traffic has steadily increased an average of about 10 passengers per day, so that a daily traffic figure of 200 passengers is now in sight. The new Berkeley operation is expected to boost this total to 300 to bring the carrier up to its break-even point.
- **Company has stayed** well within its originally projected cost level of $2,000 daily.
- **Aircraft utilization** has been hiked to 6 hr. 50 min. Operations are conducted between 5 a.m. and midnight.
- **Fares are low**—between $4 and $8.50—but because flying time on each leg of its route system is short—an average 8 min. per flight—yield per passenger mile is high.
- **Downtown heliports** are centrally located. Airport heliports are conveniently located to connecting airline flights. Downtown heliports have been constructed by the cities and are leased at low cost to SFO, which serves as a fixed-base operator and may collect landing fees from other helicopters using the facilities.

Organized in January of this year, SFO raised the necessary capital to begin operations, acquired its S-62 turbine-powered helicopters, devised its maintenance and overhaul procedures, staffed the company and began scheduled service, all within the six months. Sparking the crash program was M. F. Bagan, now president of the company, and former vice president and assistant to the president of Los Angeles Airways.

Bruce F. De Haas, vice president of operations, was also associated with Los Angeles Airways as was John J. Cunningham, SFO's vice president and assistant to the president. Unique in helicopter carrier operations is the staff of four sales people who cover the Bay area under a well-organized sales program. Each heliport terminal, modern and well-appointed, is manned by at least one agent and a porter.

Contract Provisions

The lease-purchase contract with Sikorsky includes a remove-replace clause for certain parts. Under this clause, SFO pays Sikorsky $15 for each flight hour accumulated on each helicopter. In return, Sikorsky will provide without additional charge, replacement of main transmissions, main rotor heads, intermediate transmissions, tail transmissions and tail rotor heads whenever such components are removed and shipped for overhaul to Sikorsky's plant. All other maintenance is done by SFO at its San Francisco airport headquarters.

At the time the contract was executed, the airline paid $5,000 for each of the two S-62s. At the time of delivery, the airline paid Sikorsky an additional $22,500 per helicopter as deposit. Rental rate for a period of 12 months, beginning June 1, is $5,000 per month per helicopter.

The lease may be renewed for a period of eight months beginning June 1, 1962, at a rental rate of $6,750 per helicopter per month. After May 31, 1962, the airline has an option to purchase each helicopter at the price of $228,458, less the deposit of $27,500, or a net price of $200,958. If SFO extends the lease beyond June 1, 1962, purchase price will be reduced by $5,000 for each month SFO pays Sikorsky the rental charge of $6,750.

The company holds a commitment from the Bank of America National Trust and Savings Assn., subject to normal banking requirements, for a term loan of $300,000 to help finance the purchase of the aircraft if the option is exercised. The entire financing program is indicative of the cooperation between operator and manufacturer that is necessary in today's market if re-equipment projects are to be undertaken in the face of uncertain passenger traffic growth patterns.

Engine Agreement

SFO also holds a memorandum of agreement with General Electric, manufacturer of the CT58 1,050-hp. turboshaft engine which powers the S-62. Under this agreement, General Electric will charge a fixed rate of $10 per engine hour of flight time for the supply of all major parts required for normal engine maintenance and overhaul. Minimum charge, covering all engines, has been set at $1,000 per month.

General Electric furnishes all labor for overhaul of engines at a fixed rate of $3,500 per engine overhaul. SFO pays cost of transportation of engines to GE's plant at Ontario, Calif.

SFO, in raising its initial capital, emphasized that it could not predict when it—if ever—would operate at a profit. Nevertheless, the first public offering was taken entirely within two days. The company now has 600 stockholders.

Here is how SFO raised its initial capital:

- **Company sold** 50,000 shares of $1 par value common stock to its organizers at $1 per share. On Mar. 31, these 50,000 shares were reclassified and combined on a 1-for-10 basis into 5,000 shares of Class A stock at $10 par value. Organizers then purchased 5,000 shares of common stock, 10 cents par value, at a price of 10 cents per share. Thus, organizers owned 5,000 stock units, each unit consisting of one share of Class A stock, $10 par value, and one share of common stock, 10 cents par value.
- **85,000 shares** of Class A stock and 85,000 shares of common stock were offered the public in units only, each unit priced at $11.
- **Upon completion** of the offering, public investors owned 94% of the outstanding Class A stock and 51.5% of the common stock, for which the company received $824,500 after underwriting discounts and commissions of $110,500. Thus public investors provided about 94% of the total cash invested.
- **Remaining** 5.6% of the outstanding Class A stock and 48.5% of the outstanding common stock is held by the organizers and underwriters at a total cost to them of $52,000 or approximately 5.3% of the total cash invested.

Proceeds from the sale of the units were used for basic expenses of beginning operations and spares and parts

BRIEFING

Texaco tells business and government leaders — through regular ads like this in BUSINESS WEEK — about the vital contribution local airlines are making to American business activity. • This new campaign reports on ways to use local carriers to increase sales, reduce costs, solve problems, plan promotions, and relax. • Texaco is proud of its long and close association with the airlines industry.

Texaco reports on Local Airline Services for business and pleasure

Local airline service becomes new factor in marketing strategy

Many marketing strategists are now getting a hefty assist from local airline service. Reaching a population of over 115,000,000 in 536 cities, local carriers tap more than 90% of the effective buying power in the U. S.

One sales manager covers wide marketing areas with a small sales staff by basing his men in key centers like New York, San Francisco or Kansas City—then uses local airline flights to enable those men to cover outlying buying centers.

Most local carriers schedule flights so frequently, convenient connections can easily be made among the major markets in their territories. Just recently, **Central Airlines** stepped up service to such major trading areas as Kansas City, Wichita, Salina and Topeka. **Pacific Air Lines** now provides over 100 flights daily between 31 cities in California, Oregon and Nevada. Current route systems of all domestic local airlines are available from the Association of Local Transport Airlines, Wyatt Bldg.,Washington, D. C.

Fly CENTRAL
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NEW RADAR-CONVAIRS recently acquired by Central Airlines. 30% of all local plane miles are now flown by turbine or other newer-type equipment.

Extra services give local flying added economy and comfort

Outstanding customer service is a big reason why local airline passenger volume jumped a whopping 101% in less than 5 years. Now local carriers are going all out to make local flying more convenient . . . more pleasant and economical than ever before.

Allegheny Airlines, for example, lets passengers stamp their own boarding tickets on its no-reservation commuter flights—and slashes fares by as much as 40%. **Piedmont Airlines** lops nearly 75% off the return fare on some weekend flights.

On the lighter side, **Mohawk Airlines** offers passengers free cigars and an authentic Gay Nineties decor on its "Gaslight Flights" to the beautiful New York North Country. **Aloha Airlines** even puts on a floor show en route — as ukelele-playing, native-born stewardesses entertain passengers with singing and hula dancing.

WELCOME
ABOARD

OSTRICH PLUMES and sequins for the stewardess are part of the Gay Nineties decor on Mohawk Airlines' popular "Gaslight Flights."

Local carrier sets up vital air link with Glen Canyon Dam

Indicative of how local carriers expand to meet business needs in their areas is the **Bonanza** air service to the site of Glen Canyon Dam — one of the world's biggest building projects at Page, Arizona.

Daily **Bonanza Air Lines** jet prop flights connect Page with Phoenix and Salt Lake City. Personnel of the major contractors on the dam and government officials are the heaviest users of these flights. In addition, Bonanza flies in a variety of air cargo — ranging from medical supplies to construction gear.

GIANT NEW DAM at Glen Canyon will back the Colorado up for 185 miles. Scenic flights to the dam site at Page, Arizona, can be made on Bonanza Air Lines.

Information on how local airlines contribute to America's business growth . . . prepared by Texaco Inc., Aviation Sales Department, 135 East 42nd Street, New York 17, New York.

ROSTER OF LOCAL SERVICE AIRLINES: (Domestic) Allegheny • Bonanza • Central • Frontier • Lake Central • Mohawk • North Central • Ozark • Pacific • Piedmont • Southern • Trans-Texas • West Coast • (Intra-Hawaiian) Aloha • (Intra-Alaska) Alaska • Alaska Coastal • Cordova • Ellis • Northern Consolidated • Reeve Aleutian • Wien • (International) Caribair.

including one spare CT58 engine, ramp equipment, rotor blades, one set of tail rotary blades, communication equipment, furniture and fixtures. A substantial amount of the proceeds was directed toward initial costs of the lease-purchase agreement.

SFO, which operates under constant radar control of towers in the area, has an operating performance of 97% of schedules completed. Maintenance and major overhaul work is conducted on weekends when only one helicopter is in service. Other maintenance is done between midnight and 5 a.m.

As an example of the low costs of serving as a fixed-base operator, SFO operates the downtown San Francisco heliport at a monthly cost of $50 plus 25 cents for each passenger who lands or takes off from the heliport. A nominal monthly rental is paid to the San Francisco Port Authority, in addition to the operating fee.

Airlines May Ask Fare Increases As Coach Service Losses Grow

By Robert H. Cook

Washington—Economic boomerang of the airline carriers' experience with coach service as a passenger lure is the basis of new demands for fare increases as the only practical means of improving their financial health (AW Oct. 16, p. 40).

The problem is that the greatly expanded coach service, which now accounts for 60% of the industry's seat mile capacity, has made serious inroads on first class revenues without attracting the amount of business needed to make up the difference in profit yield between the two fares.

Marketing surveys conducted by several trunklines reveal that the majority of passengers who formerly flew first class and now travel coach are businessmen ordered to do so by their companies. Due to this, most airlines are reluctant to ask for an increase in first-class fares because they fear it might spur an even greater exodus to coach travel at a time when the industry has already recorded a net loss of $15.3 million during the first seven months of this year.

Falling Profits

Profits last year shrunk to a bare $1.2 million as compared with a $61.7 million in 1959.

Alan S. Boyd, chairman of the CAB, recently advised the presidents of 11 trunklines that he thought it would not be in the public interest to discuss fare increases until the airlines first made some attempt to reduce expenses by eliminating such "frill" items as food service on coach flights.

However, he indicated CAB would consider permitting the carriers to drop some promotional fares and requested the airlines to submit detailed financial and statistical reports on these fares, along with their comments, by Nov. 3. The controversial youth fare plan has already been dropped by eight of the 18 carriers which adopted it.

In recent interviews with Aviation Week, most airline presidents favored an increase in coach fares to bring them within 85% of the price of first-class tickets, but conceded this idea clashes with CAB's low fare philosophy. The Board has already rejected several such requests earlier this year.

Late last week, United Air Lines, the nation's largest carrier, asked CAB for permission to increase first-class jet fares by $1; first-class fares on piston aircraft to the level of present jet rates; and all coach fares by 5% plus $1. Earlier last week, National Airlines had asked to raise coach fares from 75% of first-class fares to 85%.

'Prudent' Purchase

Industry rebuttal to charges that the coach problem is merely a reflection of the airlines' haste to fill high capacity turbojets, resulting in an "overcapacity" situation, is this:

The purchase of turbojets was "prudent," if not conservative, based on the industry's healthy rate of traffic growth at that time. Supporters of this theory point out that greatest seat capacity addition came in 1957 during a period of heavy route expansion and piston engine equipment.

Using the rule of the thumb that 1.5 coach seats equal one first class, this theory contends that 10% reduction in first class available seat miles, for the year ending in June, has nearly been balanced by coach seat miles, totaling 3.9 billion as against a drop of 3.8 billion for first class.

However, industry records show the 1957 total—which was 18.4% over the previous year—was followed by yearly increases of 2.2%, 12.7% and 7.4% through 1960. Revenue passenger miles during this period increased from 24.4 billion miles in 1957 to about 29 billion for the year ended in August. Load factors dropped from a 1957 average of 61.42% to only 57.37% during this period. The industry calculates that each 1% drop in load factor represents a loss of $30 million in potential revenue.

In the four years between 1958 and 1961, coach capacity went from 38% to 49.9% as of June, 1961, while first class dropped from 62% to 50.1%.

Others in the industry calculate how many coach seat miles are necessary to replace the revenue cost from reduction in first-class seat miles. Five coach fares are needed to match the average revenues from four first-class fares, they point out.

Percentage Gain

On this basis, they contend, the industry would have needed a percentage gain of 20% in revenue coach miles to make up for a 16% drop in first class revenues. Coach traffic showed a 2.25 billion gain, but would have needed a gain of about 3.18 billion revenue passenger miles to make up for the first-class loss.

Emphasizing the need for a coach fare increase to offset this loss, they noted that while coach available seat miles reached a new peak, load factors on this low profit fare have been on a steady downgrade for the past three years as jet fleets have been expanded. Coach load factors were at their highest at 64.23% by the end of 1959, but have since dropped to 60.86 for the year ending this September.

CAB Considers Plan To Speed Hearings

Washington—Rule changes designed to hold down paperwork and save time in route proceedings are being considered by Civil Aeronautics Board's rules and legislation division.

One change would bar applicants from introducing detailed exhibits of proposed schedules when seeking new route authority. Rules division said a review of past cases showed the scheduling exhibits generated a "substantial volume" of cross-examination, rebuttal evidence, and argument that expanded the record and dragged out the proceeding.

In the streamlined route proceeding, emphasis would be on the needs and sizes of the markets involved, the traffic the applicants expect to generate, and the type of equipment that is to be used.

The other change would stop route applicants from introducing evidence concerning other points not specifically named under the guise of "prayer for general relief." This practice often surprises other applicants when a carrier introduces exhibits under this heading to seek route authority already applied for by others. Both changes were recommended by the Board's procedure committee, and the practitioners' committee created last spring to seek ways to expedite litigation.

Kodak's simple approach to looking and finding

The message is simple: we solicit assignments to make apparatus that finds distant sources of radiance or that points to them with any desired precision.

The message is simple because we do not fear simplicity. Students of current trends in military technology sometimes get the impression that simplicity is best avoided as injurious to the national interest.

What can be simpler than a roll of film? Or more complex and sophisticated than the organization required to make it so that it will perform reliably and well? And there you have the key to our personality, equally applicable to us when making non-photographic infrared scanners or gyro-correcting astrotrackers.

We don't lose interest beyond the breadboard stage; first-class production engineering is our strength. We can also work in harmony as a simple supplier of infrared and visible sensors, optics, and filters to the creative artists of the breadboard, who deserve all the encouragement they can get. There's a living for all.

Our basic position in infrared components and admiration for simplicity of design led us not long ago to build this piece of hardware. It is an infrared scanning head useful with multichannel oscillographs for radiometry of faraway warm spots. It also contains an array of gas-discharge lamps that wink significantly in correspondence to IR imaged by a Schmidt system on a 50-element array of Kodak Ektron Detectors. While the image is oscillated across the line of detectors, the line of lamps is effectively swept in synchronism across the visual field of the beholder. He sees a picture of a 20° chunk of the infrared environment for search and track of objects only a few degrees different in temperature from the background.

Another type of Kodak search-and-track device of an optical nature is ready for breadboarding. This one will be small enough to ride in a space vehicle, along with a computer and an inertial platform. It permits the gyros to be lighter than the demands of precision would otherwise dictate. The computer tells our gadget where to point in the sky to find a certain star. (It can see stars perfectly well in daylight, of course.) It looks there, but the directions turn out to have been a little erroneous. It thereupon centers itself on the appointed star and reports an error signal back to the computer. The computer finds this information of great value.

We are afraid that our device to do all this is too complicated to explain here. Not everything can be simple.

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If there are any questions, or if you want to set up a discussion on the relationship between your needs and our capabilities in our fields of activity, or for a mere copy of a booklet entitled "Kodak/a force in being," write Advanced Planning Department,

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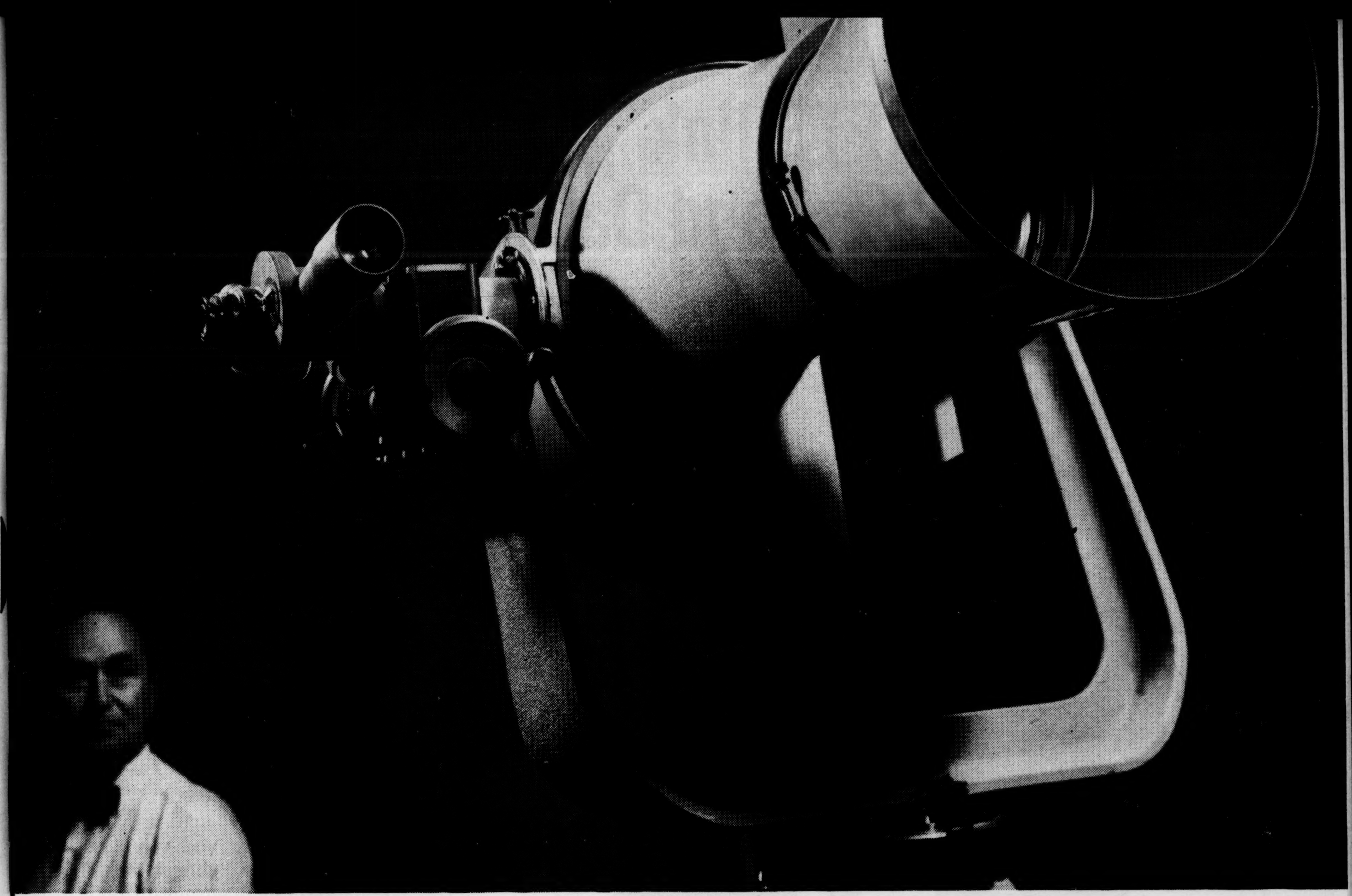

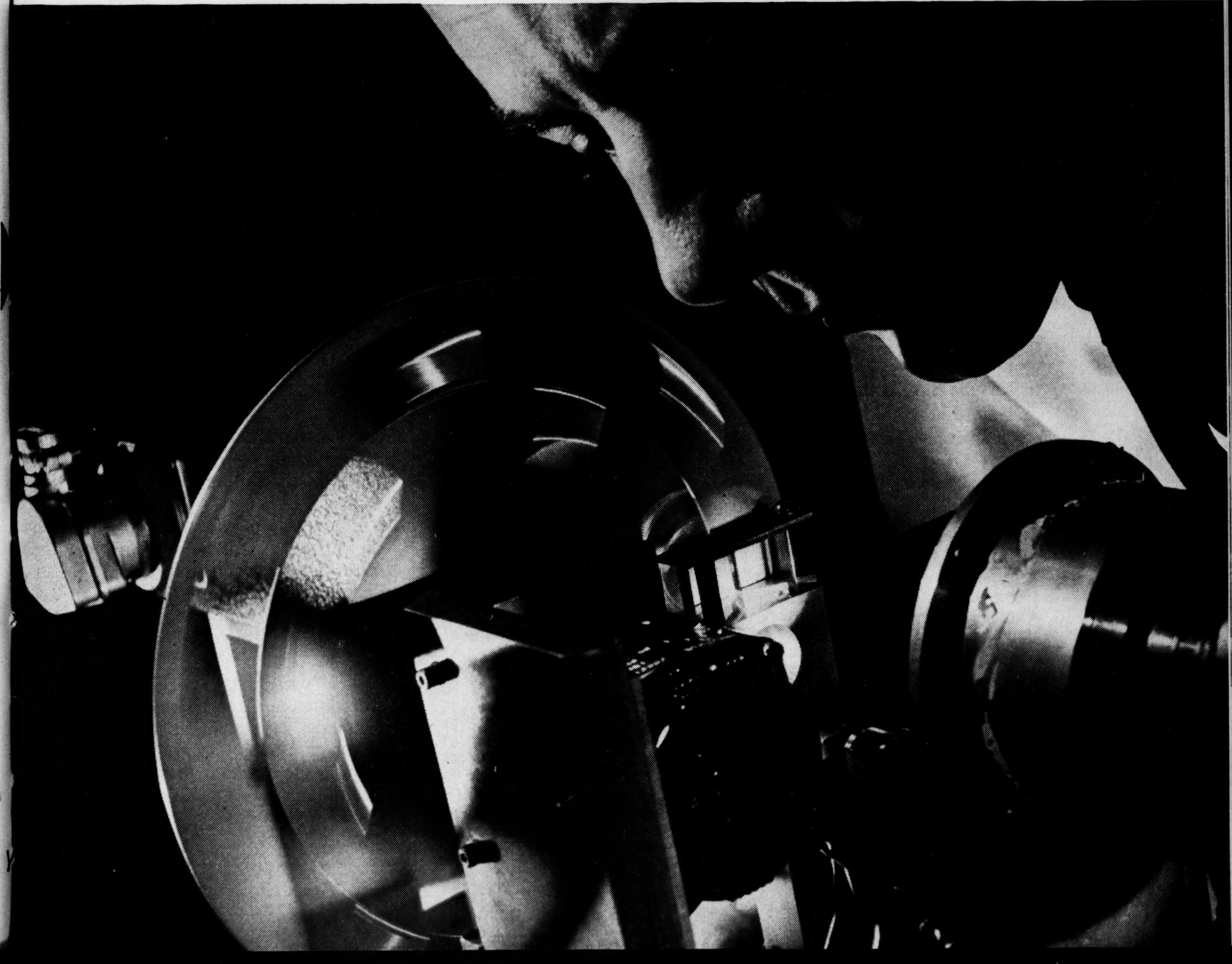

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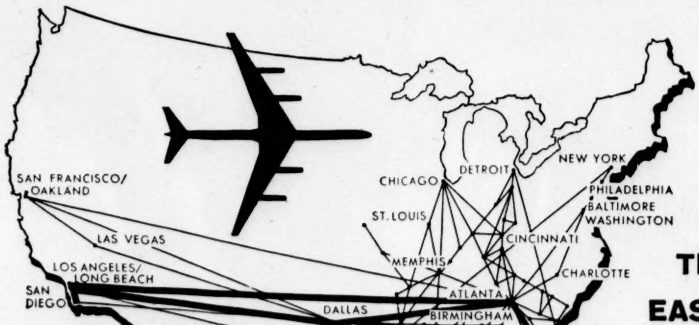
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3 ROUND TRIPS DAILY— EAST and WEST

DELTA

THE AIR LINE WITH THE BIG JETS

General Offices: Atlanta, Georgia

Four Carriers Accept Labor Peace Findings

Four large carriers last week accepted a presidential commission's recommendations for labor peace, but bitter opposition expected from the flight engineers raised the possibility of a second major airline strike within a year.

American Airlines, Eastern Air Lines, Pan American World Airways and Trans World Airlines, all of which employ four-man flight crews, formally notified the White House of their acceptance less than two days after release of the Feinsinger Commission's findings (AW Oct. 23, p. 35).

Along with National Airlines, Western Air Lines and Flying Tiger Line, these carriers were shut down by a week-long strike of the Flight Engineers International Assn. last February. The commission was appointed Feb. 21 to investigate the cause of the strike, which arose from the cockpit jurisdiction dispute between FEIA and the Air Line Pilots Assn.

In final form the commission report recommended three-man crews on all turbojet operations, and extensive pilot training for flight engineers on jets.

The flight engineers, with the security and future of some 2,700 members at stake, can be expected to reject almost every provision of the report. The bulk of FEIA's membership on trunk carriers is concentrated at American, Eastern, National, Pan American and Trans World Airlines. The union is free to strike all of these carriers, with the exception of National, which recently signed a new contract with the union and has been employing a three-man jet crew.

FEIA's master executive council met last week to discuss what stand the union should make on the report. A strike appears likely, since the Feinsinger findings are only recommendations and the basic issues, as negotiations resume, have not changed since before the February walkout.

Adding to FEIA's disapproval of the report is the failure of the commission to force Western Air Lines to rehire flight engineers who walked off during the February strike. Western was the only carrier which refused to do so, ignoring a plea from Secretary of Labor Arthur Goldberg that all parties maintain a status quo during the commission's study.

The presidents of the four major trunklines, in telegrams to President Kennedy, expressed their appreciation of the commission's efforts to settle the labor issue "which has plagued the airline industry for many years," but made it clear that they are concerned over the cost of adopting its recommendations.

Airline Income and Expenses—July, 1961

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenues	Total Operating Expense	Net Income Before Taxes
DOMESTIC TRUNKS								
American	31,440,970	569,826	337,642	1,968,197	....	34,703,204	34,906,483	−203,279
Braniff	5,566,949	126,126	57,001	216,787	35,335	6,092,152	6,224,431	−268,442
Continental	5,344,000	83,000	32,000	133,000	....	5,715,000	5,231,000	259,000
Delta	11,158,000	207,000	102,000	404,000	....	12,024,000	11,703,000	126,000
Eastern	19,853,588	424,799	....	890,109[1]	....	21,210,204	23,122,524	−2,083,106
National	6,406,667	141,630	34,925	235,154	83,517	7,072,542	6,754,452	118,715
Northeast	4,295,000	61,000	25,000	74,000	....	4,535,000	4,981,000	−446,000
Northwest	6,503,261	187,695	....	422,832[1]	4,662	7,177,132	6,865,128	82,894
Trans World	22,990,851	448,958	....	1,461,656[1]	105,990	25,360,489	25,161,756	−614,159
United	40,596,642	1,253,160	....	2,645,557[1]	116,479	44,851,767	44,019,303	50,451
Western	5,504,679	99,938	....	191,132[1]	83,676	5,892,016	5,573,132	143,800
INTERNATIONAL								
American	511,940	6,274	363	67,468	....	614,225	590,556	23,669
Braniff	817,528	42,611	....	60,420	....	966,868	1,066,169	−121,070
Caribbean Atlantic	329,243	2,623	....	17,845[1]	970	355,781	308,175	48,222
Delta	164,000	....	....	5,000	....	176,000	220,000	−48,000
Eastern	3,381,896	49,162	....	156,101[1]	....	3,589,976	2,860,261	660,556
Mackey	162,837	....	477	4,464	....	188,816	176,106	11,257
Northwest	2,457,593	634,403	....	328,717[1]	186,383	3,763,971	2,790,544	848,133
Pan American Combined	36,898,000	2,413,000	....	3,975,000	3,430,000	48,003,000	40,183,000	6,666,000
Alaska	541,000	18,000	....	55,000	....	616,000	620,000	−6,000
Atlantic	18,492,000	1,117,000	....	1,623,000	2,456,000	24,241,000	19,834,000	4,400,000
Latin America	9,265,000	222,000	....	1,187,000	111,000	11,374,000	9,539,000	1,851,000
Pacific	8,600,000	1,056,000	....	1,110,000	863,000	11,772,000	10,191,000	1,547,000
Panagra	1,413,000	64,000	....	265,000	8,000	1,988,000	1,836,000	108,000
South Pacific	85,289	390	....	1,047[1]	....	86,383	128,210	47,185
Trans World	7,786,810	640,523	....	666,170[1]	282,647	9,617,057	8,003,028	1,315,561
United	3,086,190	95,299	....	81,895[1]	....	3,612,715	2,186,506	1,082,581
Western	524,201	5,587	....	11,475[1]	....	542,805	428,213	100,914
LOCAL SERVICE								
Allegheny	1,116,794	19,377	19,296	32,527	4,332[2]	1,758,614	1,735,427	−35,055[3]
Bonanza	447,670	3,824	1,824	5,370	....	751,546	688,811	36,731
Central	319,844	11,967	3,623	13,333	698	726,319	667,820	54,956
Frontier	626,276	16,656	4,918	29,443	3,776	1,319,336	1,194,700	62,628[3]
Lake Central	469,372	9,448	12,164	10,082	402	859,099	896,145	−56,175[3]
Mohawk	965,384	13,577	13,400	18,836	54,285	1,344,280	1,382,155	−39,283[3]
North Central	1,537,855	31,578	28,696	35,303	2,568[2]	2,401,955	2,053,412	328,632
Ozark	645,538	15,279	14,780	24,107	5,743	1,099,667	998,951	87,894
Pacific	565,465	11,536	3,368	9,654	1,513	940,579	844,588	70,468
Piedmont	749,253	10,298	8,496	12,442	11,154[2]	1,209,663	1,121,326	64,433[4]
Southern	471,182	17,132	8,782	15,614	1,220	905,169	843,472	23,132[3]
Trans-Texas	451,329	11,942	4,794	16,186	1,961	847,053	852,740	−13,773
West Coast	571,401	9,226	1,675	15,309	1,419	1,040,413	914,860	106,269
HAWAIIAN LINES								
Aloha	576,349	1,769	....	5,559	12,500[2]	662,006	546,598	92,094[3]
Hawaiian	807,210	2,826	....	77,755	8,276[2]	945,868	748,867	178,296[3]
CARGO LINES								
Flying Tiger	....	4,770	....	819,568[1]	1,915,080	2,760,069	2,611,624	15,618
Seaboard World	1,230,519[6]	358,308	....	103,844[6]	....	2,281,346	2,182,307	27,689[3]
HELICOPTER LINES								
Chicago Helicopter	114,188	135,898	....	....	....	250,422	268,122	−17,656
Los Angeles Airways	26,881	11,806	15,098[5]	....	....	147,375	130,456	17,760
New York Airways	95,252	3,549	1,980	3,149	....	303,421	333,383	−32,393
ALASKA LINES								
Alaska Airlines	204,139	45,392	586	50,536	145,620	673,103	741,902	−12,889
Alaska Coastal	125,820	8,443	....	12,424	7,172	210,764	189,322	19,268[3]
Cordova	23,225	9,212	....	16,839	46,848	128,389	126,359	−1,820
Ellis	81,600	4,200	....	7,800[1]	1,600	126,100	121,900	2,100[3]
Kodiak	22,093	935	....	3,058	14,514	42,381	36,870	5,373[3]
Northern Consolidated	148,275	56,316	....	43,888	....	376,118	315,500	21,800[3]
Pacific Northern	905,406	79,958	2,653	123,576	1,044	1,258,320	1,055,180	199,922
Reeve Aleutian	154,790	40,556	....	47,984	26,633	273,330	170,993	102,209
Western Alaska	58,491	76,243	....	7,387	36,909	179,698	139,076	14,588[3]
Wien Alaska	217,060	77,202	....	48,954	98,268	586,229	507,405	66,213[3]

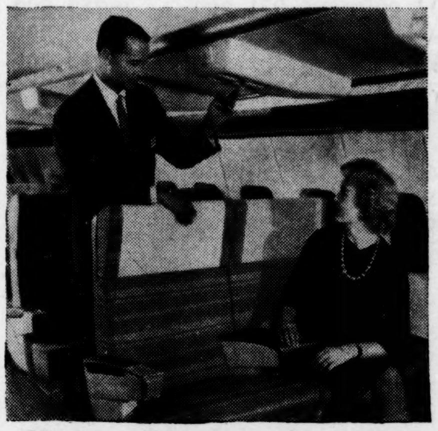
[1] Property. [2] Non-scheduled transportation. [3] Net profit or loss. [4] Airlines excess baggage. [6] Charter.

Figures for Trans Caribbean and Avalon were not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

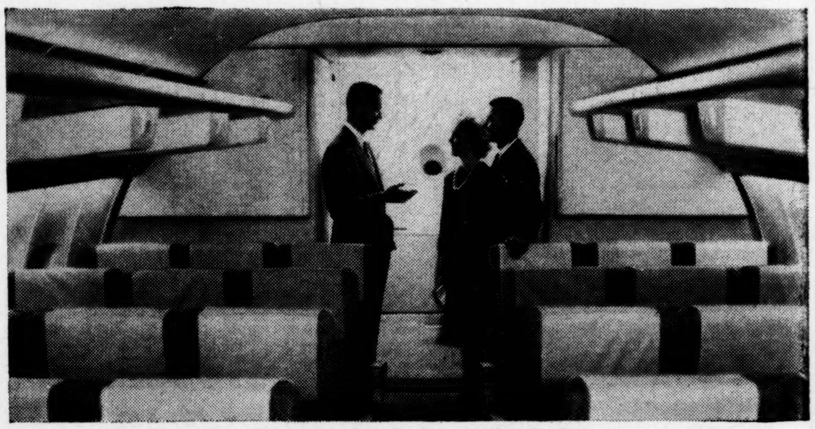
Preview of the new short-range Boeing 727

727 has 3 rear-mounted engines



Mock-up of 1st class cabin section

Integral rear stairs to cabin



Wide 727 cabin permits 6-abreast high-density seating

Shown above are photos of scale models and a full-size mock-up illustrating some of the outstanding features of the new Boeing 727 short-range jetliner.

Designed to produce an operating profit even at modest load factors, the 727 is a high-performance jet that will service 150- to 1700-mile routes, operating from 5000 foot runways with full payload.

The 727 brings airlines many short-route features, including quick takeoff, rapid climb to cruise altitude, low approach speed, the durability required for frequent takeoffs and landings, and integral airborne stairs to help reduce ground time during short stops. Capacity ranges from 70 first-class to 113 tourist-class passengers, plus 850 cubic feet of heated and pressurized cargo space. Another unique 727 advantage is the incorporation of many systems and components proved out in more than 350,000,000 miles of Boeing jetliner operations.

Already, American Airlines, Eastern Air Lines, Lufthansa German Airlines and United Air Lines have ordered 117 Boeing 727s for delivery beginning late in 1963.

BOEING 727

SHORTLINES

▶ **Allegheny Airlines** reports it carried 74,080 passengers over 15.3 million revenue miles last month, a 12% increase over the same period last year.

▶ **American Airlines** reports a net profit of $1.6 million for the third quarter this year, compared with $4.4 million for the same period last year. Revenues for the same periods, respectively, were $109.8 million and $116 million.

▶ **Dallas to Mexico City** jet service via San Antonio will be started by American Airlines this week with one round trip daily. Northbound flight will continue to Washington/Baltimore after Dallas. Southbound flight will originate in Chicago.

▶ **Civil Aeronautics Board** is studying minimum rates for foreign and overseas Military Air Transport Service charters. Board wants to determine whether short-term MATS call contracts involve higher costs to carriers and, if so, whether the rate minimums should be raised for these operations.

▶ **Federal Aviation Agency** has approved Allison 501-D13 turboprop engines powering Eastern Airlines' and Pacific Southwest Airlines' Electras for 2,000-hr. operation between overhauls.

▶ **International Air Transport** Assn. reports 205,238 passengers and over 2.1 million lb. of freight were carried over the Atlantic by scheduled airlines last month. Passenger load factor was 50.4% last month compared with 65.3% a year ago. Cargo showed an 11.4% increase for September compared with the same period last year.

▶ **Lockheed Aircraft International** has received a $779,000 contract from Garuda Indonesian Airways to provide it with technical assistance.

▶ **Pan American Airways** reports the Pratt & Whitney turbojet engines that power its jet fleet have experienced inflight failure once in 40,000 hours with in-flight shutdowns once in 5,000 hours.

▶ **Trans World Airlines** has asked Civil Aeronautics Board to approve a new reduced freight tariff to become effective Nov. 17. New rates provide a 47% reduction for commodities such as musical instruments, ceramics and plastics moving coast-to-coast. Chemicals, advertising matter, drugs, auto and aircraft parts and similar items would get a 37% reduction.

AIRLINE OBSERVER

▶ Accident investigators have discovered that Federal Aviation Agency's master approach chart for Boston's Logan Airport pinpoints the location of the Instrument Landing System Middle Marker as .8-mi. from the end of the airport's ILS runway, but that the marker is actually only .2-mi. from runway threshold. Error may have been a factor in a recent accident in which an American Airlines Boeing 707 overshot while landing and skidded into shallow water off the runway's takeoff end.

▶ **United Air Lines is using an analog computer to test autopilots. Used as a backup to the manual system pending certification by the Federal Aviation Agency, the computer completes tests in 15 min. as compared with seven hours on the manual system. There have been no rejects due to computer tests, and prior to its adoption, autopilots were being returned for overhaul about every 600 hours. Standard maintenance procedures called for overhaul every 1,000 hours.**

▶ Mexican aviation interests are protesting that shortages of air traffic control facilities are endangering airline operations into Mexico City. One criticism is that the airport lacks an Instrument Landing System, surveillance radar and high intensity approach lights, forcing some pilots to transmit position reports "in the blind" to warn other aircraft of their position. Another complaint to the government noted that Mexico's 13,628-naut.-mi. airway system is served by only four VORs, nine radio ranges and 41 non-directional homing beacons.

▶ **Riddle Airlines has attained a daily aircraft utilization rate of 11 hr. with its Armstrong Whitworth Argosy all-cargo transports.**

▶ Airframe and engine manufacturers are stepping up their competitive sales programs aimed at local service airlines. Attendance of manufacturers' representatives at the Las Vegas meeting last week of the Assn. of Local Transport Airlines was more than double that of past meetings.

▶ **Caravelle Mark 10 jetliners purchased by Trans World Airlines will be outfitted with Bendix PB-20 autopilots and dual series 300 flight directors and CB-60 gyro-compasses, made by Eclipse-Pioneer Division. Original Caravelles, including those purchased by United Air Lines, were equipped with Lear autopilots. Bendix also has sold its PB-20 autopilot for use on the BAC-111 twin-jet transport.**

▶ Interline committee of the Air Line Pilots Assn. will delay its demands for a union-wide vote on calling a special ALPA directors' meeting to debate methods of settling the 17-month-old Southern Airways pilot strike (AW Aug. 28, p. 38). Committee members have enough ballots to press the issue but feel recent measures taken by ALPA President C. N. Sayen and the union's executive committee should be assessed first.

▶ **Local service airlines are apprehensive about the new air-truck plan devised by Air Cargo, Inc. A popular idea with trunk carriers, the plan has not been well received by short-haul airlines which feel that airfreight moved into a metropolitan area by trunklines should complete its journey by air.**

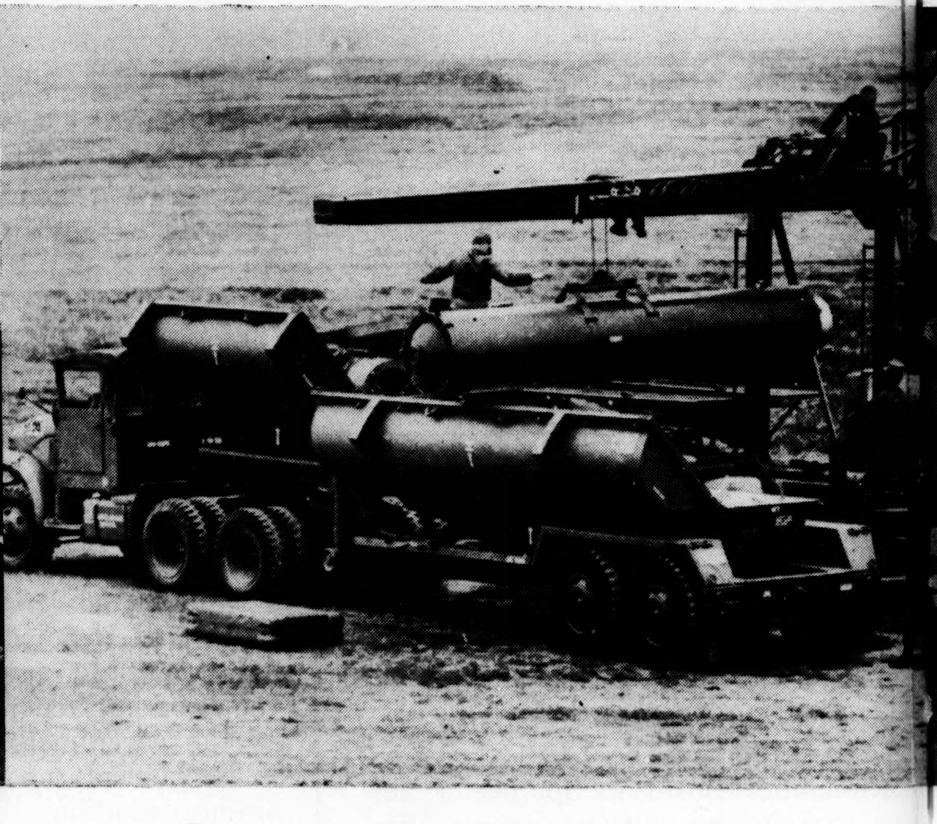
▶ Airline managements have mixed emotions about the Department of Commerce national transportation policy report, scheduled for delivery to the White House this week. In recent speeches, department officials have indicated the report will re-emphasize the need for airline user payments to the government, along with recommendations that would eventually make railroad services highly competitive with medium- and short-haul airline operations. The report may also explore the airline industry's tax and depreciation policies.

▶ **Federal Aviation Agency plans to require the installation of flight recorders on all non-airline, turbine powered aircraft weighing more than 12,500 lb., or certificated to operate above 25,000 feet. The change would primarily affect F-27 and Viscount corporate aircraft.**

Half-mule, half-bird The U.S. Army's Sergeant, now in production, is artillery, and it can traverse terrain where caissons used to go rolling along. And for long, fast hops, the Sergeant can readily be airlifted. The prime contractor, Sperry Utah, wisely selected new, light gages of USS "T-1" Constructional Alloy Steel with 100,000 psi yield strength for the ground support special purpose equipment. USS "T-1" Constructional Alloy Steel is three times stronger than structural carbon steel, thus fabricated components can be made thinner and lighter with no sacrifice in strength. The entire launcher is air-transportable because it weighs only 16,000 pounds—7,000 pounds less than if built with structural

Steel "Keeps America's strength high."

Wide use of USS "T-1" Steel makes the transporter-erector-launcher 7,000 pounds lighter and completely air-transportable.



Frame components of special purpose container transport trailers are "T-1" Steel; launcher boom is also "T-1" Steel, for maximum strength and minimum weight.

All major structural components were designed at an allowable working stress of 66,700 psi.

carbon steel. When your missile support system goes on the drawing board, you can obtain applications and development assistance by consulting the one producer of all basic materials for support hardware and facilities. Whether it's carbon steel or special constructional alloy steels, electrical cable or wire rope...consult

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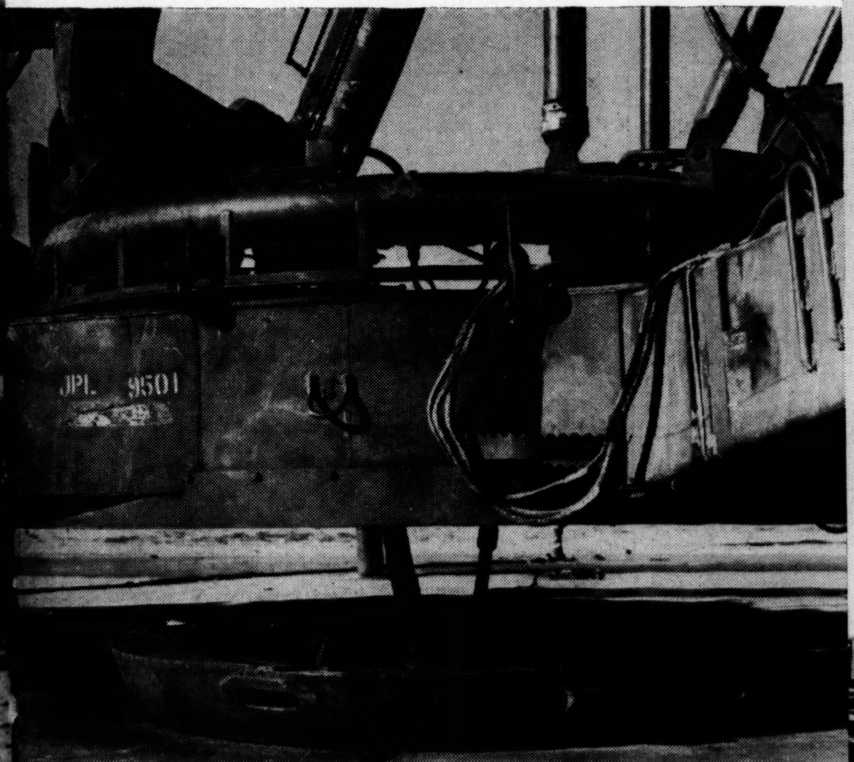
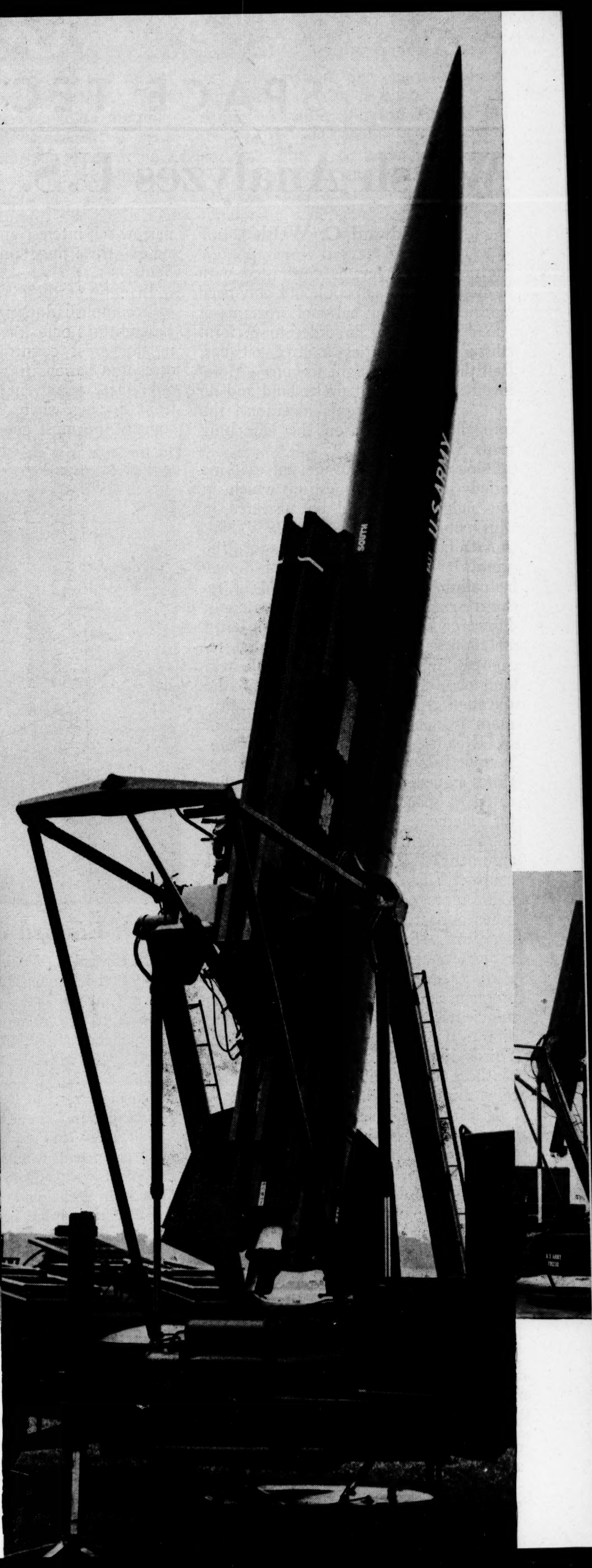




6½" diameter welded USS "T-1" Steel tubing forms the torus ring of the launching superstructure.

USS "T-1" Steel outrigger legs stabilize the unit in firing position. Also made of "T-1" Steel are the U-frame, extension arms, top and rear tension members and back beam.

Welsh Analyzes U.S. Space Expenditures

By Edward C. Welsh

In a democracy, as contrasted with a dictatorship, the people not only need to understand the national programs of their government in order to perform their responsibilities as free citizens, but they have the right to know. Moreover, if they do not understand and do not accept the national decisions, the program will fizzle on the launching pads.

Consequently, I want to examine briefly some of the questions which, in my judgment, should be answered in this public education effort:

- **Aren't there better uses** for the money? It isn't a question of money actually, but rather a question of resources, manpower, skills, materials. However, I phrase the question in terms of money because those essential resources are the things money will help obtain. In part, the answer to the question is simply that the space program is not an either/or proposition.

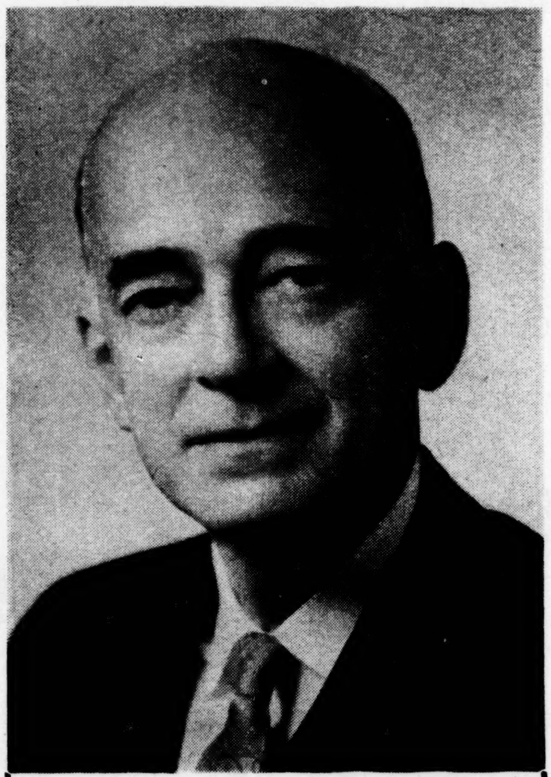
Of course, there are other very important uses for our money. It is sometimes argued that the funds being allocated to space should better be spent for medicine, schools, housing, research, and full employment. That argument is misleading on several counts. First of all, we could spend a lot more on those worthwhile purposes and still increase our space expenditures. Second, we did not spend enough money on those worthwhile purposes even before we had a space program, and there is no assurance that sufficient would be spent even if we didn't now have a space program. Third, directly or indirectly every one of those worthwhile purposes will receive some of the space money.

It is indeed serious that we have overcrowded schools, inadequately trained teachers, and obsolete education equipment. Money for these purposes is sometimes difficult to obtain because of narrow prejudices and an oversupply of provincialism and ignorance.

It is indeed serious that we have a number of unemployed persons, willing to work but unable to find jobs. Monopolistic practices of private corporations and other organizations sometimes contribute to this situation and, I might also add, narrow prejudices again come into the picture.

It is indeed serious that sufficient funds are not made available for medical care, as well as for slum elimination and better housing. Again, we find narrow self-interest and emotional prejudice thwarting progress in these fields.

In none of these cases is the failure to accomplish due either to our space expenditures or to the lack of resources in this great country. Rather, prejudices and various forms of self-interest often act to prevent sufficient money from flowing where it would do the country the most good. The fact that a vigorous space program will increase our wealth and our ability to improve our standard of living leads me to another broad question.



Dr. Edward C. Welsh

Dr. Edward C. Welsh, executive secretary of the National Aeronautics and Space Council, is an economist who reached his present position after eight years on the staff of Sen. Stuart Symington (D.-Mo.) where he was staff director for the 1956 airpower hearings, and staff director for President Kennedy's Defense Reorganization Committee last year.

Called by Vice President Johnson "the most competent man in government," Dr. Welsh was graduated from Lafayette College in 1930, and received masters and doctorates from Tufts College. He taught at Tufts, the University of Cincinnati and Ohio State University. He joined the government in 1942 as an Office of Price Administration executive, and held positions with economic agencies until he joined Sen. Symington's staff in 1953. He is 52, and a native of New Jersey.

This article is from a speech Dr. Welsh gave at the American Rocket Society's Space Flight Report to the Nation.

- **Will the billions of dollars** spent on space put a strain on our economy? The answer is definitely in the negative. Of course, space programs are costing money and will continue to cost more money, but, spending money per se does not strain the economy. What does put a strain upon the economy is wasting resources. While various aspects of the space programs may not be handled as efficiently as desired, it is a program of production rather than of waste. It increases our scientific knowledge which in turn increases production; it employs personnel and stimulates education; it strengthens progress in medicine, in metallurgy, and in propulsion; it increases and improves various essential services, such as communications and weather reporting. In brief, the space program will increase both the size of the gross national product and its rate of growth.
- **How much will the space** program cost? Space explorations, space travel, and a wide variety of other space activities will become increasingly characteristic of our way of life. It is impossible to predict costs with any degree of accuracy very far into the future although we do know what it is costing now, and we have some useful estimates for the costs during the next few years. This year, our accelerated space efforts will cost between $2.5 and $3 billion. This total will increase over the coming years so that it may average about $5 billion a year over a five-year period. To help place these figures in perspective, I note that during that same half-decade the people of the United States will average about $25 billion per year for recreation alone. This presents a 5 to 1 ratio of recreation expenditures over space expenditures.

Production Stimulant

Put in another way, it is estimated that during the coming five years or so, our total space expenditures—not just the money spent for exploration of the moon—will average approximately 1% of our gross national product. While absorbing that relatively small percentage of our gross product, it will at the same time be stimulating a sharper rate of increase in the country's production of goods and services.

I do not want to leave the impression that the cost will be insignificant. The contrary is true. The space program will become more and more expensive. It could amount over the next five years to an average per capita cost of $125, i.e., $25 per year or 50 cents per week. That is a rough estimate, which might be off a little in either direction. In any event, it is not unreasonable to assume that during the next five years the average income in the U. S. will increase more than 50 cents per week. If it does, the cost of the space program to the individual can be readily absorbed.

Since the most expensive and most hazardous project in our current space effort is the manned round trip to the moon, another appropriate question occurs.

- **Is the lunar trip necessary?** The answer is "yes." Let me say, however, that it is not easy to give an educated answer to a question about something which has never been accomplished.

I have heard a number of seriously expressed declarations of ignorance on the subject of space. I will cite two examples, the first of which you have heard many times before: "Why go to the moon? Why don't we stay here and watch our television sets like God intended us to?" A comparable statement was made with intense seriousness in a public meeting by a man in high public office. He asked: "Why spend our money to go flying around in space? If there are people up there in Mars, let them spend their own money and come down here and show themselves."

Those examples reflect the thinking of the type of people who considered the horseless carriage, the surgeon's scalpel, and indoor plumbing as works of the devil. If they had had their way, the wheel would have been smashed with stone-headed clubs as soon as it was invented. Incidentally, you may have heard or read that some scientists are opposed to the moon program. There may be a few who take that position; not many, but a few. Why? Well, this may come as an astonishing thought to some, but scientists are people almost the same as the rest of us. Seriously, however, some scientists are afraid that so much of the money involved will go for the production of hardware that not much will be left to go to foundations, universities, and research organizations for deliberate and careful scientific study. They do not challenge the need for space exploration. They are for that. However, they want to send scientific equipment and not use spacecraft space on men and food and safety equipment and oxygen tanks, and so forth.

The advantages of men in space vehicles seem to me to be obvious. There are observations, maneuvers, actions, and inactions concerning which decisions can be made by men and cannot be made by instruments alone. These facts are equally applicable, in my judgment, whether the spacecraft is on a mission to maintain the peace or on a mission devoted solely to increasing our scientific knowledge.

But, why the moon? The fact is that there is no other place so near in space where we can test the equipment and the men for future space travel. To reach the moon is a tangible objective in a sane space program—and any practical program sets targets in time toward which the activity is geared. For a moon trip we need the following: powerful rockets, sophisticated spacecraft, trained and carefully selected astronauts, and a protection against the multiple hazards of space travel. These are requirements for all outer-space exploration and the moon project gives a chance to develop them. Moreover, we can be certain that any nation which can successfully master this objective can do many other things which can threaten or protect the world's security and which can contribute greatly to the scientific knowledge so important to improved living on earth.

This reference to the international significance of space exploration suggests another question:

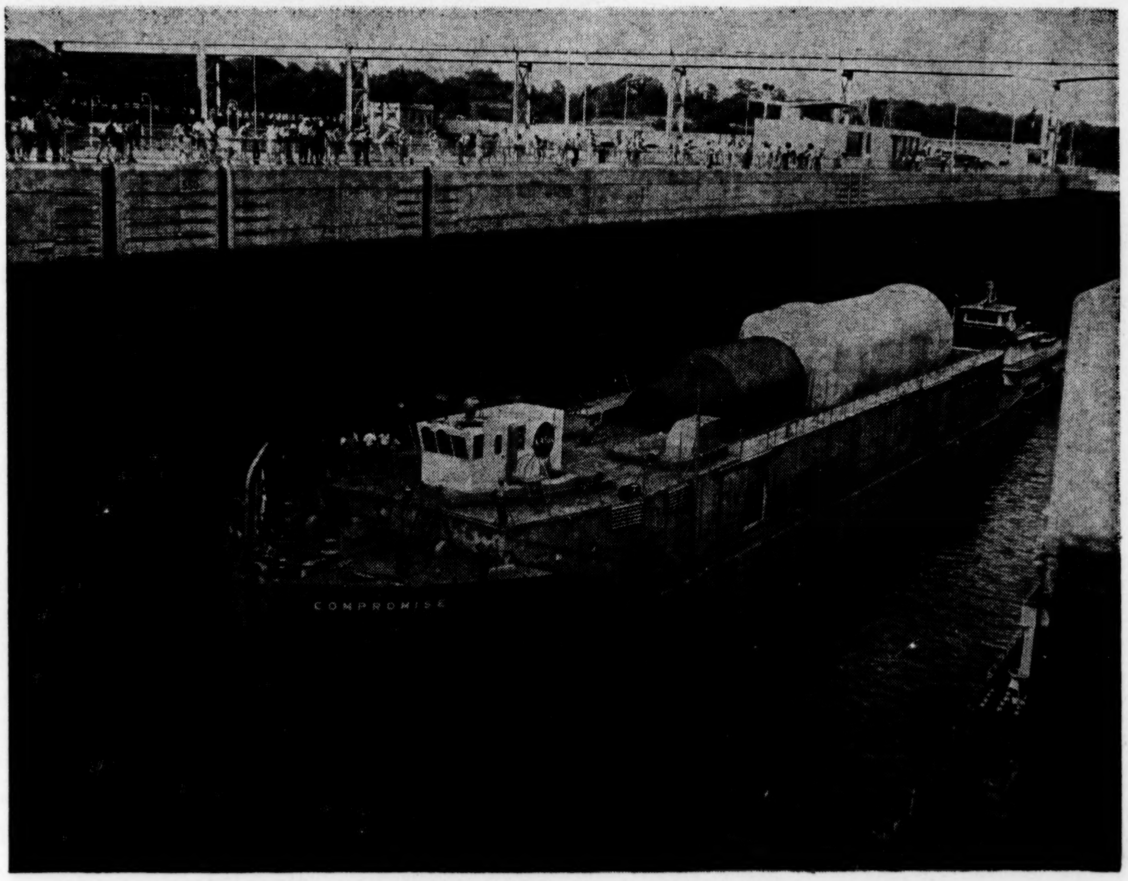
- **How does the U. S. compare** with the USSR in the space race? Of course, we know with more exactness what the U. S. has accomplished than what has been developed by the USSR and what new information they have obtained. However, based upon such data as is readily available, the following would seem to be a reasonable capsuled comparison. The U. S. leads in the number of successful launches by a margin of more than 3 to 1. We also have obtained a wider range of scientific information about space and have made more progress in applying space technology in the weather, navigation, and communications fields. We can speak less positively about comparative progress in guidance and systems reliability. It is clear, however, that the Soviets are ahead in the single most critical aspect of the race: the ability to put heavy payloads into space.

While we are making an effort to overcome this "booster-lag," we must assume that the Soviets are not waiting for us to catch up.

Inventory Needed

In order to meet this space challenge, we should take an inventory to determine what we need in resources and what we can do to supply these needs in quantity and particularly in sufficient quality. This raises the question:

- **Are we really deficient** in the resources necessary to attain space leadership? Next to time—a resource whose supply we cannot increase—the scarcest essential is quality manpower. The process of increasing this supply is slow and, hence, we must accompany our educa-



Saturn Stages Transported to Cape Canaveral

Operational stage and dummy second stage of Saturn booster, aboard the Saturn barge Compromise, pass through a lock on the Tennessee River during trip from Huntsville, Ala., to Cape Canaveral. Vehicle on the barge is SA-1, first Saturn research and development rocket, which is due to be launched soon. Barge name indicates it was selected as means of transportation after another lock on the river collapsed, trapping larger barge upstream.

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YOUR NDT NEEDS ARE NATIONWIDE? So are Magnaflux facilities. MAGNAFLUX MATERIALS TESTING LABORATORIES are so widely used, all around the country, many people think they are part of a separate company. Not so! This is a part of Magnaflux Corporation, set up to serve you either of two ways: You bring your test needs to our Lab or we come to you with fully-equipped Mobile Labs . . . in your plant or out in the field—airport, overhaul plant, oil rig, bridge, wherever you need it.

MTL provides all the Test Systems of Magnaflux—including radiography, magnetic field measure, others. Further, since the service is nationwide, every laboratory can help every other, whatever your need. This is a real pool of equipment and men. Principal enthusiasts are airlines, missile and aircraft producers—plus a hundred or so major industrial plants—for maintenance and production.

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Testing becomes, as it should, a part of product planning. We call this "system engineering". It goes far beyond too many common ideas of "testing". It's not something done because you must, but because it saves money, keeps the product true to its purpose—not just to meet specifications but to work and operate as it should.

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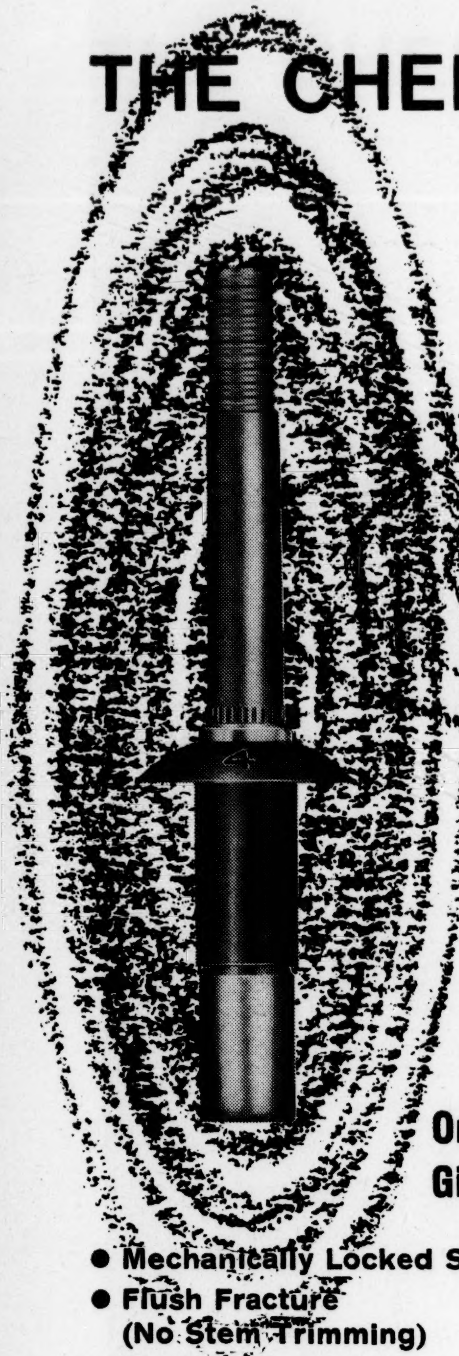

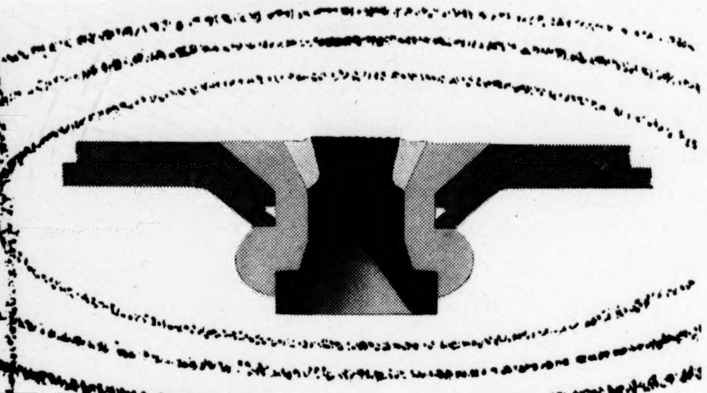

THE CHERRYLOCK TEAM

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A-286 Stainless Steel—Monel—Aluminum

The Cherrylock* "2000" series team offers the finest, most adaptable aircraft rivets yet developed. Maximum joint strength and reliability are obtained by using the Standard Cherrylock and the Bulbed Cherrylock to cover the entire range of applications. The Bulbed Cherrylock for short grips and double dimple, the Standard Cherrylock in the longer grips. Both types are installed with the same H-610 series pulling head, using existing Cherry guns.

Higher joint strength allowables, close blind side clearance, and the widest grip range available—only with the Cherrylock Team—result in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

* * *

For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent No. 2931532

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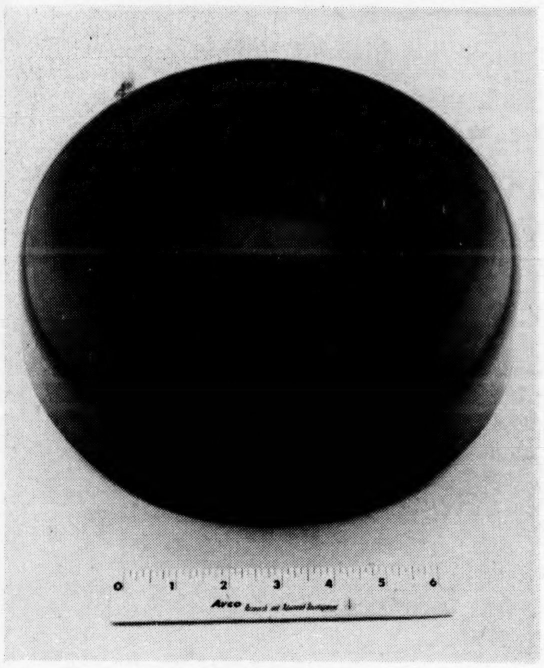
tional efforts with a vigorous program aimed at making better use of the small numbers of able and well-trained people available. This applies not only to scientists and engineers, but also to a wide variety of other competences as well. The justifiable emphasis placed upon training in the so-called basic sciences and in engineering should not, for example, exclude equally great emphasis upon administrative talent. The demands for professional skill in management are going to become greater because the needs will become more complex and the problems of coordinated and integrated efforts more difficult. We are, in fact, moving from a process characterized by somewhat isolated experiments to an era of enormously complicated expeditions in which every element must fit together properly if success is to be attained.

Your government, wherein lies the major responsibility for the space program, is experiencing considerable difficulty in obtaining competent technical and management personnel. The intangible rewards for assisting the government in this great mission are frequently more than outweighed by the salary opportunities provided by private industry. I might add that in many instances the taxpayer pays the salary, either directly, if on the government payroll, or indirectly, as a part of the cost of a contract with private industry.

Low-Quality Hardware

On the other hand, the big challenge to industry is not so much that of obtaining capable people, although it has that problem also, but rather is to establish much higher standards of quality in the space hardware it sells to the government. Our space successes so far have been seriously limited by low-quality products from private companies.

The fields of technology and business management are, moreover, not the only areas in which there is a large need for more highly trained individuals. This demand also dips into the social sciences. For example, economists and fiscal experts are needed to help plan the mobilization of our resources so as to minimize waste and to limit impairment of other national goals. Political scientists and lawyers are needed to develop the necessary legislative framework, space law, and solutions for a wide range of international problems. Sociologists and psychologists will be concerned with personnel training, worker motivation, and the growth of new communities associated with expansion of the space business. Language specialists will also have an important role. There will be an enormous job of communicating the meaning of space to the public, writing the technical manuals, and perhaps, even some day of developing means for communication



Re-entry Nose Cap

Silica reinforced epoxy nose cap, using the charring ablation process, has been developed by Avco Corp. for materials testing on the Scout four-stage solid propellant vehicle. Re-entry temperatures will be measured by 26 thermocouples inside cap.

with forms of life on other planets. I believe it is a fact that few students and few curricula will remain untouched by the growing demands of the space age.

As we proceed to expand our educational efforts, we must also take giant steps toward improving the communication of technical knowledge, new discoveries, and improved engineering practices. A central clearing house for such information is definitely needed. Technical organizations like the American Rocket Society can contribute significantly in this whole educational process.

In brief, the answer to the question as to whether we are deficient in resources is not too discouraging. Of course, we have shortages, and they will become even greater. However, if a positive national program is coupled with a vigorous national effort, we need not fear that manpower shortages will be the primary cause of failures. Rather, unnecessary failures are most likely to come from insufficient effort in marshalling the resources we have available.

It might help to round out this broad touch on the education problem, by citing some of the things accomplished this year in the space program.

The following is a partial list:

(1) The Space Council has been activated to give the President coordinated policy recommendations on all aspects of the space program; (2) Basic decisions have been made to accelerate our space efforts, including the setting of specific space objectives such as manned lunar explorations, global communication satellite systems and global weather satellite systems; (3) Large rocket engine programs—liquid, solid, and nuclear—have been speeded up; (4) Funds for this over-all acceleration have been requested of and obtained from the Congress; (5) Improved procedures have been established for coordinated action on the part of the several government operating agencies engaged in the space program; (6) Actions have been taken to strengthen the organization and administration of the space program within the government, including increasing and reassigning personnel strength; (7) A national policy has been issued for the communication satellite system; (8) More successful space shots have been made and more valuable space information and experience have been obtained than in any comparable period.

In conclusion, I suggest two broad generalizations: First, the space program will give the greatest impetus to education since the development of movable type, and, second, the more fully the general public is kept informed and understands the significance of space exploration and space developments, the more successful can our efforts be toward world leadership in the space field.

We must win the space race unless we want to become a second-rate nation in technology, in science, and in world influence. More important still, the outcome of this race may well determine whether or not freedom becomes a second-rate commodity.

Nuclear Detection In Space Under Study

Bedford, Mass.—Study contract to develop ground-based optical techniques for detecting nuclear explosions in space through observation of sunlight has been awarded to Geophysics Corp. of America here by USAF's Aeronautical Systems Division.

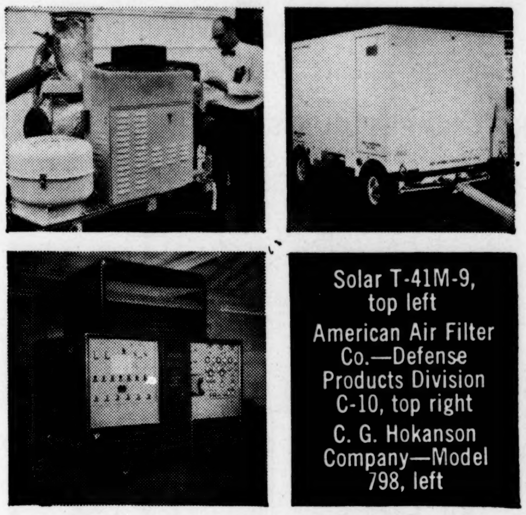
Dr. Edward R. Manring, project manager of Geophysics' optical program, said photometric equipment can be developed to ascertain from earth traces of nuclear explosion debris elements at great distance in space by studying sunlight scattering.

The firm has studied many elemental species expected to be found in nuclear debris in space, Dr. Manring added, and is preparing theoretical tabulations of probable special characteristics of each after an explosion.

Equipment developed under the project will be based on familiar principles in airglow and auroral photometry, he said.

The contract, third awarded to Geophysics for high-altitude nuclear explosion detection research, is part of the Defense Department's Project Vela studies to develop effective and reliable techniques for use in international control of a possible nuclear test ban treaty.

Barber-Colman temperature controls chosen by leading makers of ground support equipment



Solar T-41M-9, top left
American Air Filter Co.—Defense Products Division C-10, top right
C. G. Hokanson Company—Model 798, left

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Today's air and space vehicles call for a growing array of ground support equipment. Shown above are a few examples of support units employing Barber-Colman temperature control systems. Components used include: control boxes, actuators, valves, temperature sensing elements, and thermostats. The systems are specifically engineered for each application through the teamwork of the ground cart manufacturer and Barber-Colman.

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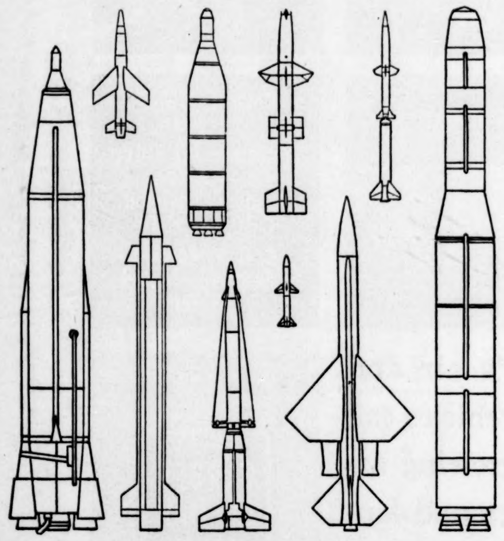

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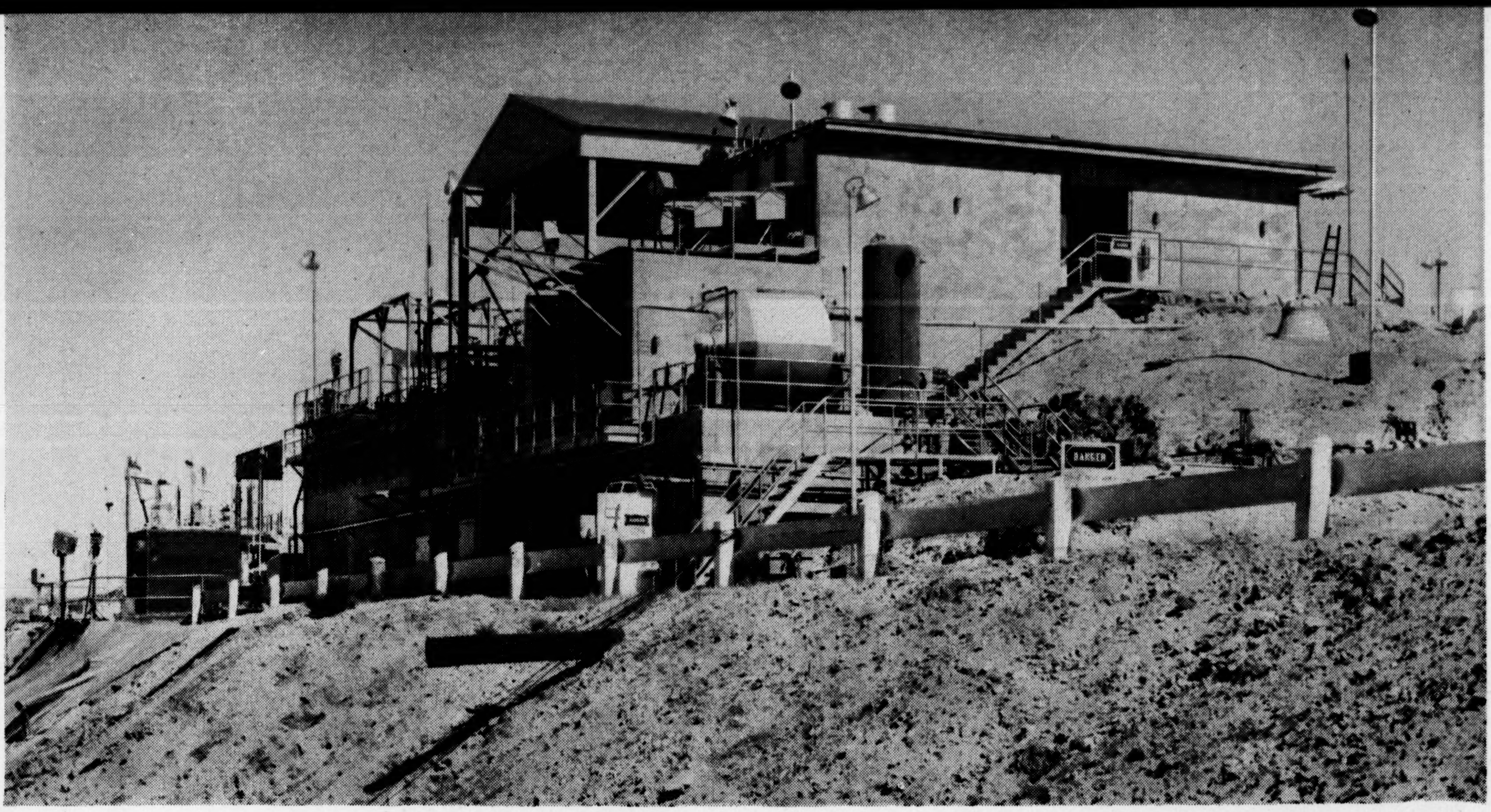
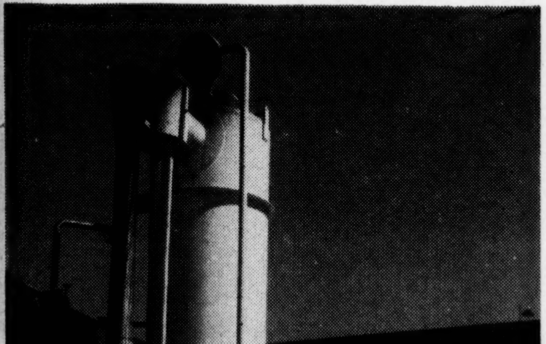


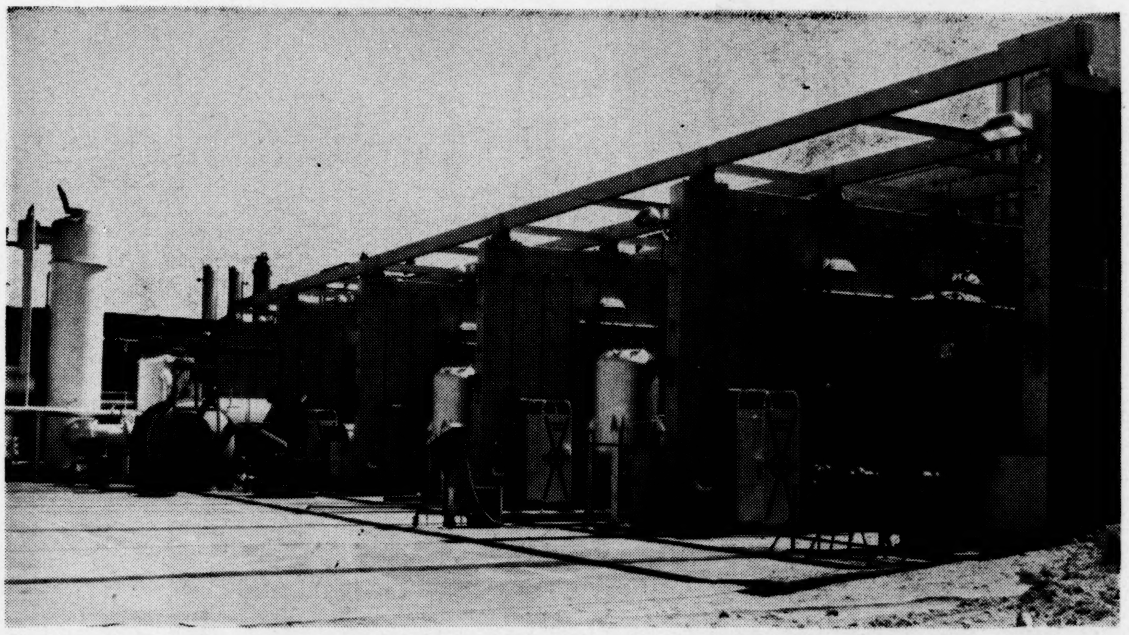
Engines with thrust ratings of up to 100,000 lb. are tested horizontally on this Edwards AFB test stand for Air Force Systems Command.

Edwards' Rocket Facility Checks Out Components

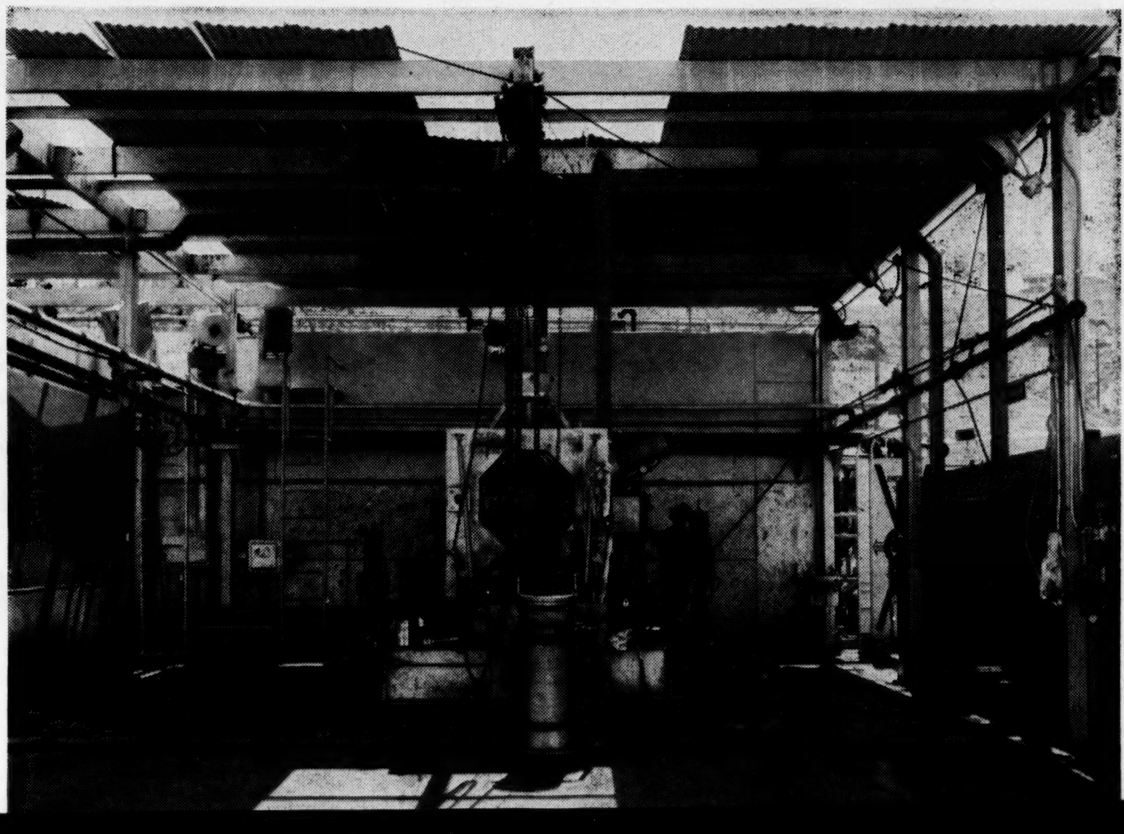
Edwards' Rocket Facility low-cost cell, used to check out engine injectors and propellant combinations, has four test stations—two rated at 50,000-lb. thrust, and the other two at 40,000-lb. thrust. Surplus Army tanks are used as observation points. Dynamic and static tests are made on valves, regulators, pneumatic controls and other rocket engine subsystems at the Rocket Facility's component testing station. Test stand at the facility is used to test new propellant combinations, thrust chamber designs and engine components.

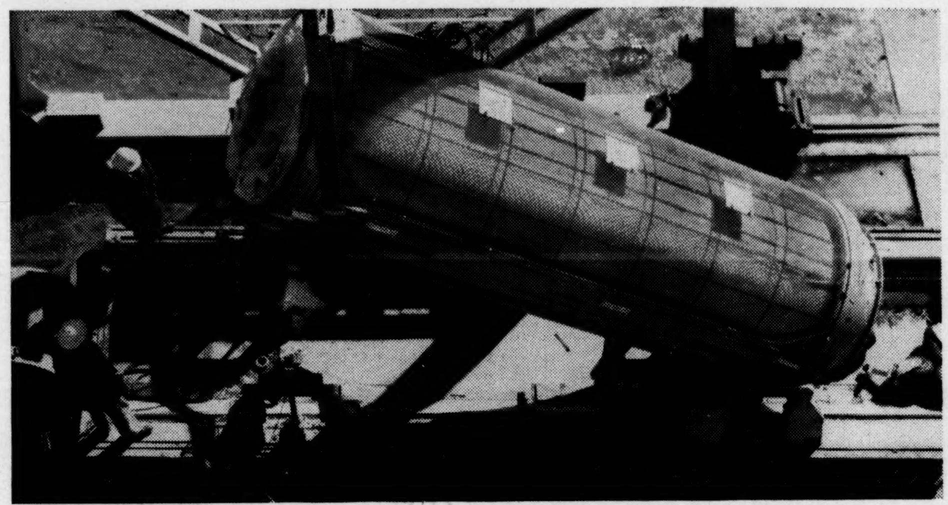


Altitudes up to 100,000 ft can be simulated in this vacuum chamber at the Edwards AFB Rocket Facility. Chamber is used to test low thrust, lightweight rockets.



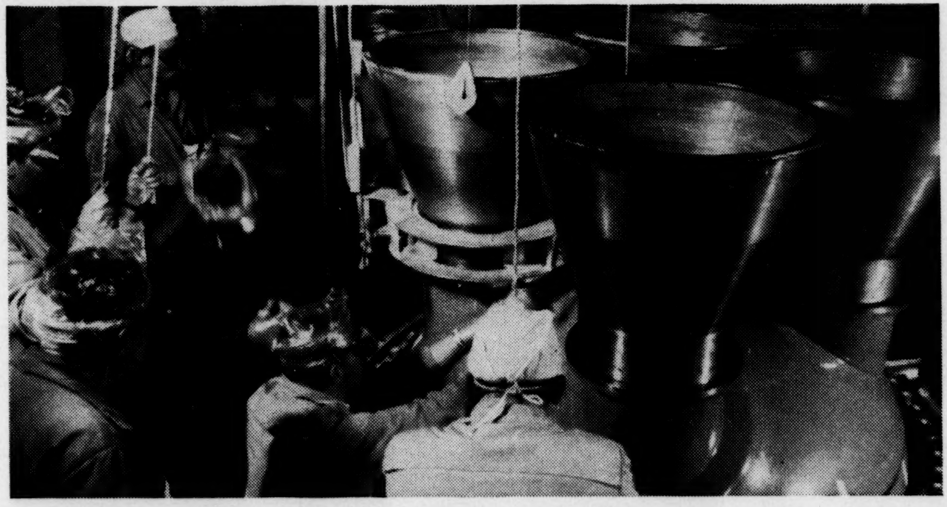
Component test facility at the Edwards' Rocket Facility consists of a series of cells and chambers through which gases and fluids are pumped to simulate flight environments (top). Rocket engine injectors and propellant combinations are tested in low-cost cell (below).

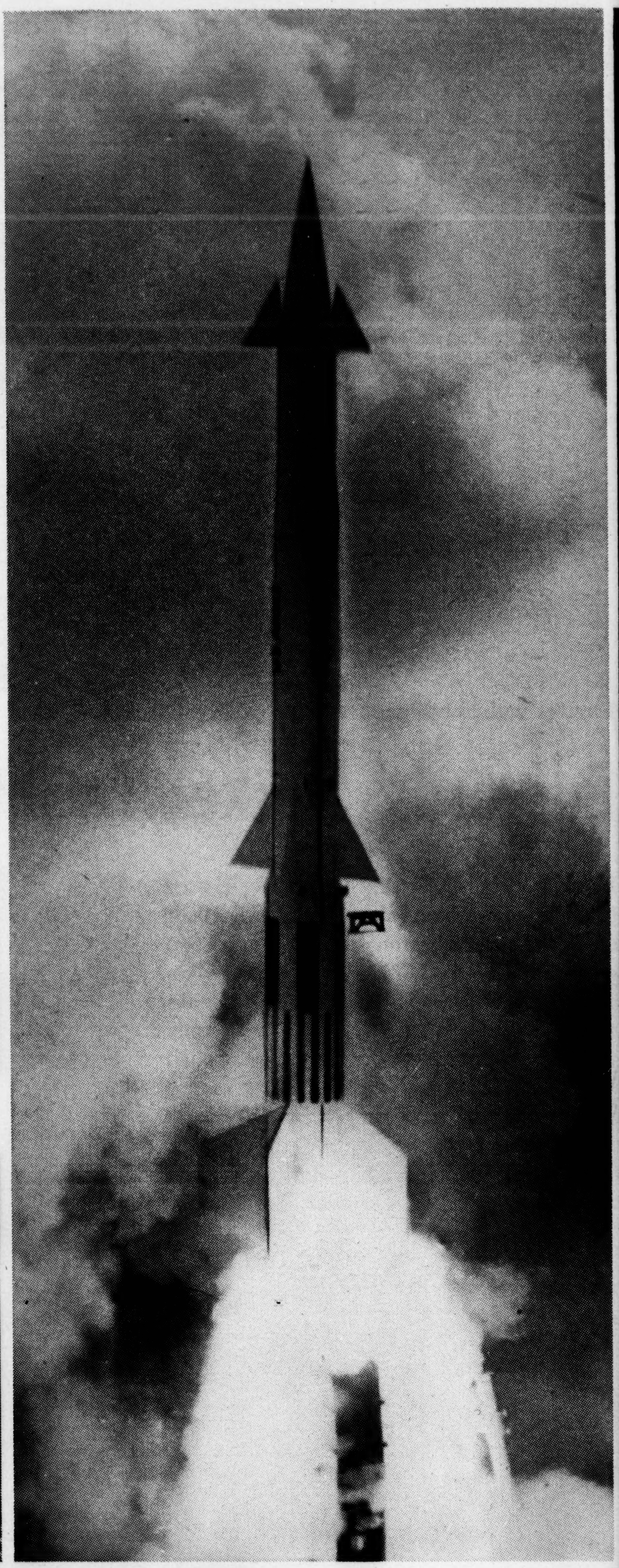




Thiokol's Wasatch Division...now turning out the largest flight-tested solid rocket engine of record, Minuteman first stage...is capable of producing engines of satellite size. Plant growth: from 17 to 120 buildings since 1957.

Experience in developing and managing facilities of this size is required in order to create and manage the still larger facilities needed to produce and test tomorrow's big boosters. Managerial capacity: a known factor at Thiokol.





BENCHMARKS in the

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As early as 1952, Thiokol recognized the need for the economy and reliability of giant solid rockets in our country's defense and space efforts. In 1956, the Corporation allotted and invested millions of its own funds in research and production facilities to meet these requirements and assigned its skilled management, engineering and technical teams to man plants and lab-

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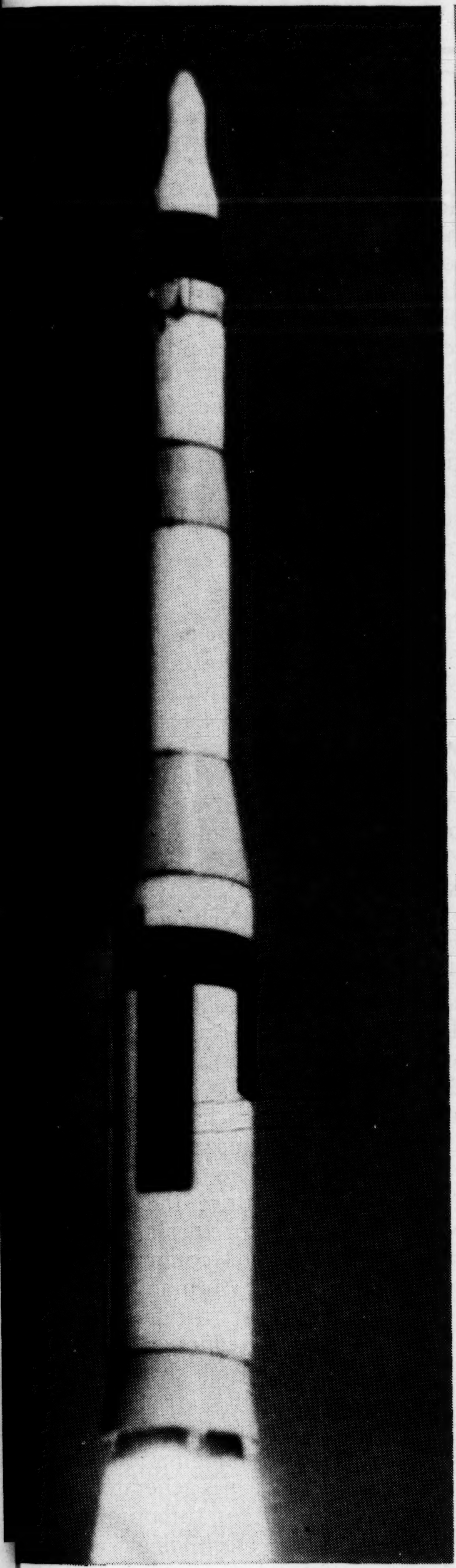

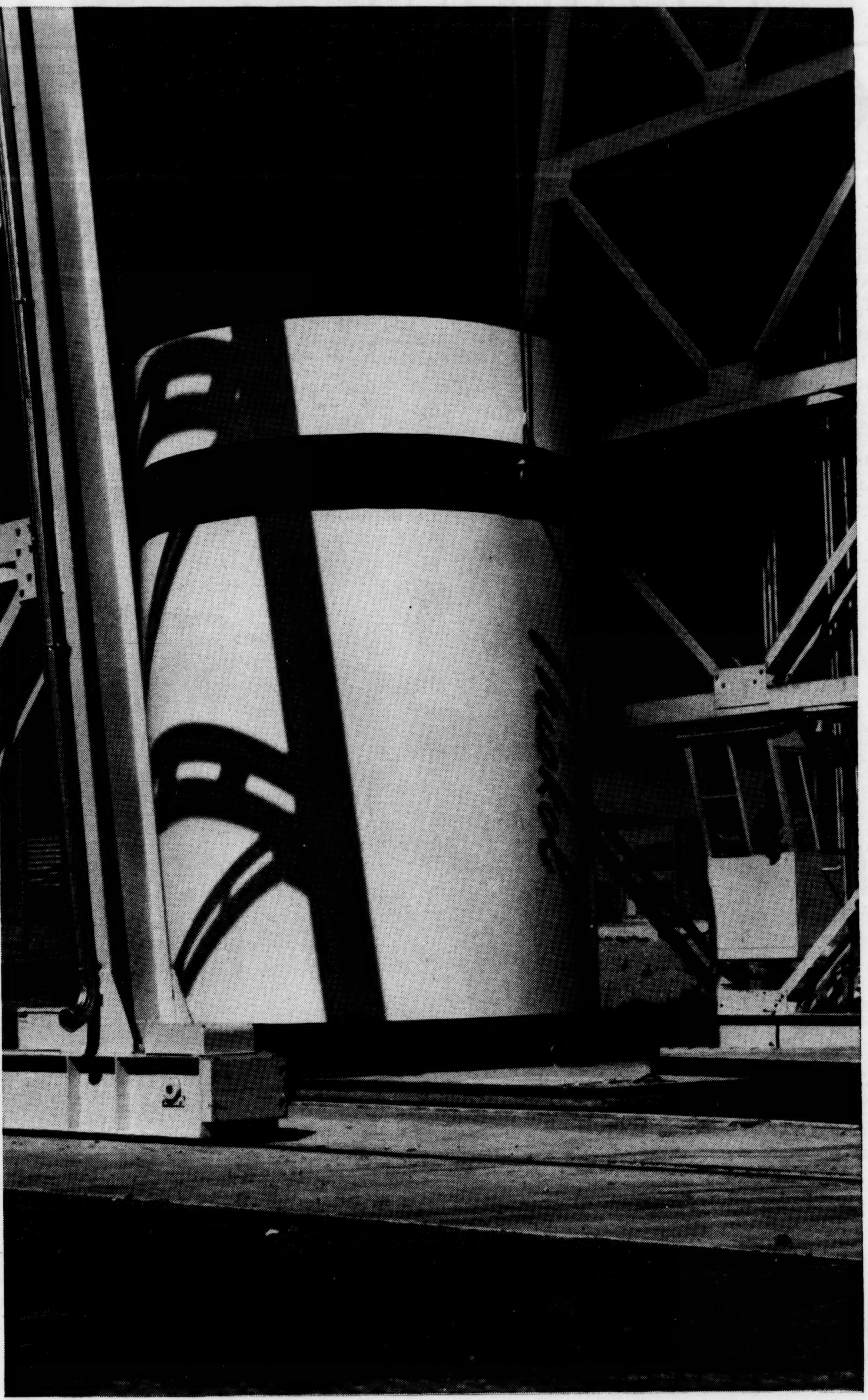

science of rocket propulsion

oratories. Having moved with rocketry through early frontiers, Thiokol is well prepared and well equipped to meet the challenge of the new frontier. □ Thiokol has designed, developed, and produced the most powerful and also the largest flight-tested solid rocket motors on record...Zeus, with 450,000 pounds thrust, and the first stage engine for Minuteman.

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GE Sees Variety of Uses for T64 Engine

By David H. Hoffman

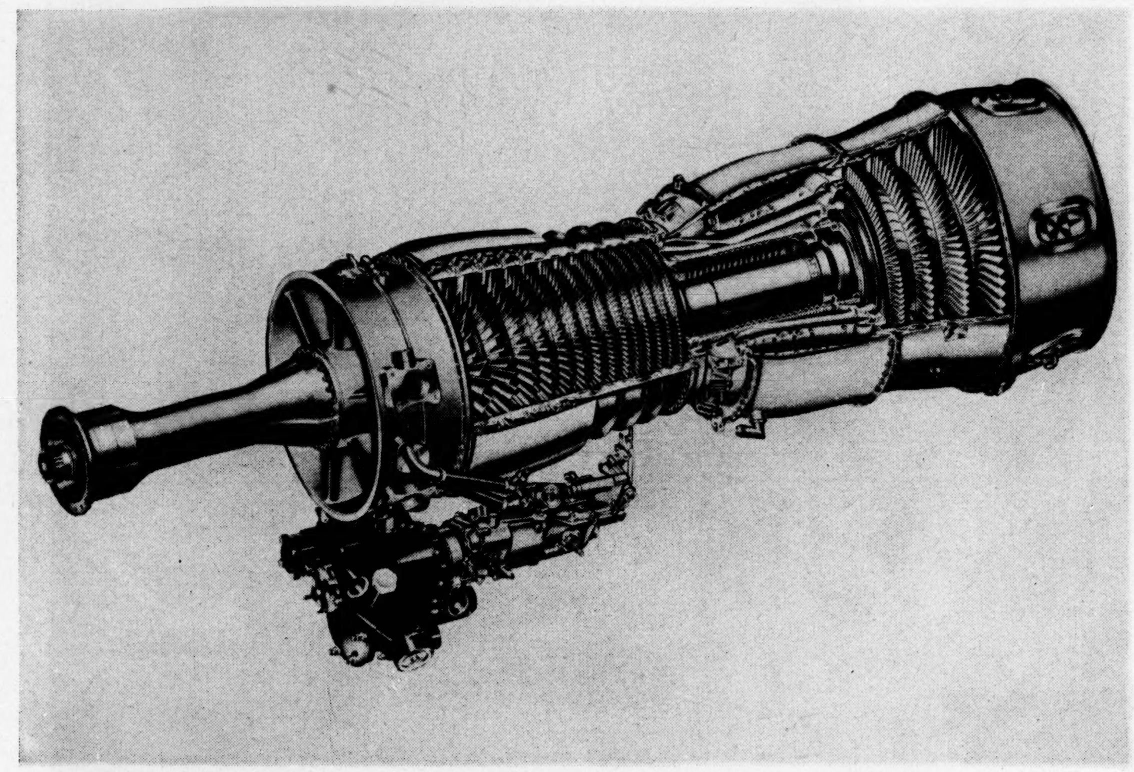
Lynn, Mass.—General Electric is predicting that its T64 turbine engine—competitively alone in the 2,500- to 3,500-shp. power class—will play a leading role in powering the larger V/STOL aircraft scheduled to appear during the next decade.

First funded by Navy in 1957, the T64 passed three significant milestones last month: it was selected to power the Ling-Temco-Vought, Hiller, Ryan tri-service VTOL transport; it was flight-tested for the first time on a de Havilland Caribou; and it completed a formal, 150-hr. qualification test using JP-4 fuel.

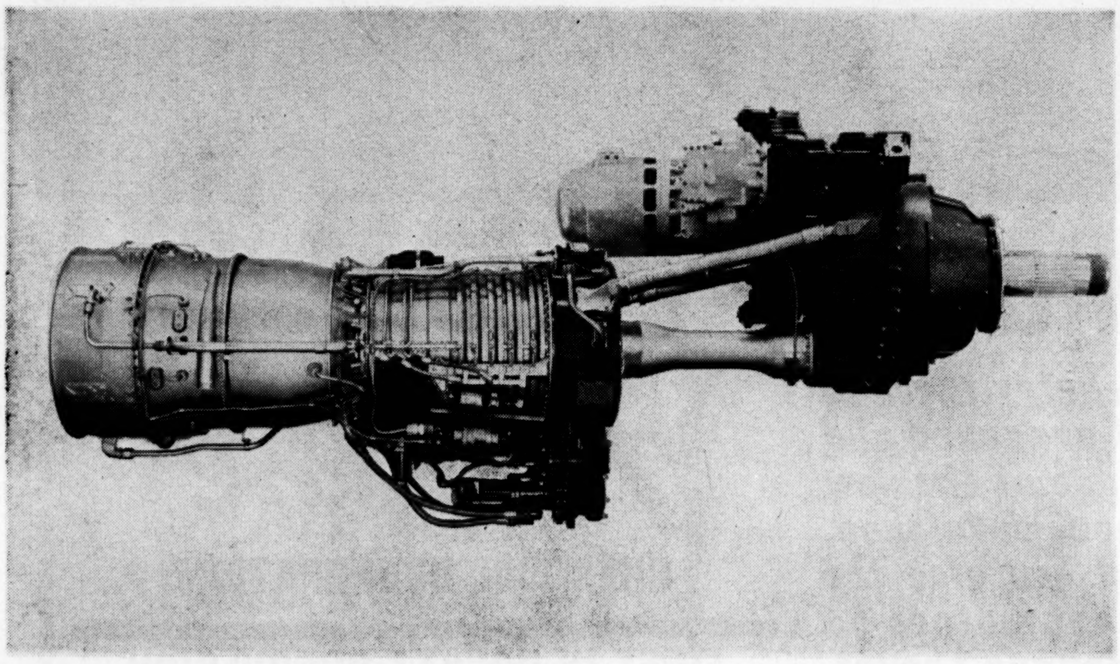
In developing the T64, GE took the best designs and components it had on hand and combined them into one powerplant. The engine itself, however, breaks no fresh ground in metallurgy, nor does it offer a power-to-weight ratio equal to that of the GE T58.

Although its specific fuel consumption of about 0.495 at sea level is considered a strong point by GE, the engine's turbine inlet temperature of about 1,700F, its compressor pressure ratio of 12.6 to 1 and its best power-to-weight ratio of about 4 shp./lb. have been surpassed by other production engines.

Nevertheless, GE believes these numbers describe a balanced engine that satisfies a variety of propulsion requirements while meeting design goals of simplicity, versatility and low fuel consumption.



CUTAWAY of T64-6 direct drive engine exposes 14-stage compressor, two-stage gas generator turbine and two-stage power turbine. Note that rear compressor stages have "grouped" rotor blading to hold down tooling costs. Split compressor casing and pre-weighted blades enable field removal without major engine disassembly.



T64-8 is essentially the -4 except that its propeller shaft has been offset above the gas generator center line, again for operators' convenience. As a result, height of the -8 is increased 10 in. to 46 in. Powerplant's other dimensions are identical to T64-4.

Comparative Engines

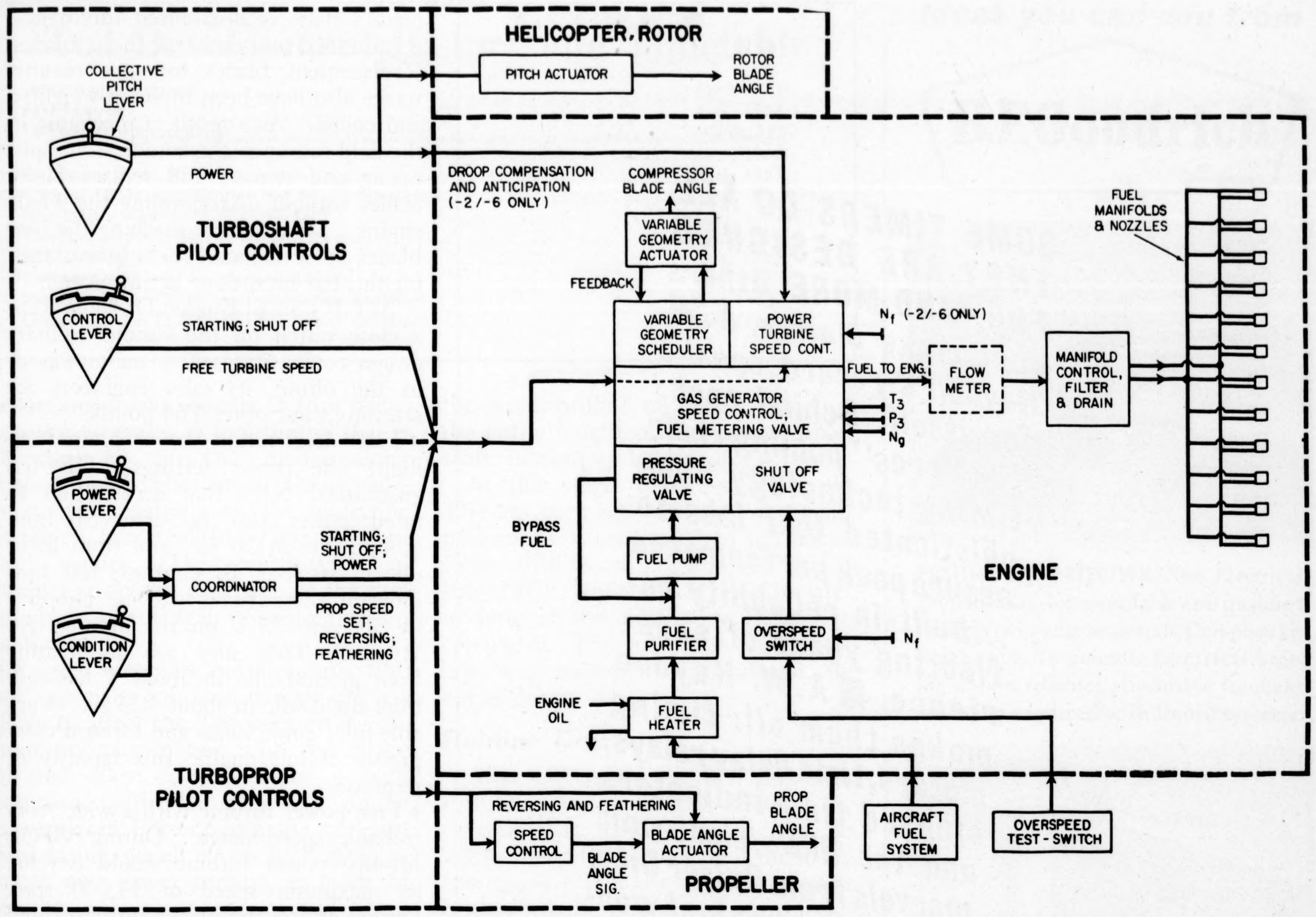
The power class occupied by the T64 is bracketed on the high side by General Motors-Allison T56 series engines which develop 3,750 to 4,585 eshp. and power Lockheed Electra and C-130 transports. Pratt & Whitney JFTD-12A-3 turboshaft, rated at 4,050 shp., also is a more powerful engine than the T64. On the low side, the T64's closest competitor is the Avco-Lycoming T55, a turboshaft engine that develops 2,200 shp. and powers the Boeing-Vertol Chinook helicopter used by the Army.

The T64 has a 14-stage, axial flow compressor that pumps air at the rate of 24.5 lb./sec. into the engine's short annular combustion chamber where externally mounted nozzles and two low-voltage igniters are located. Expanding gases then drive the engine's two-stage gas generator turbine, which in turn drives the T64 compressor. A two-stage free power turbine just aft of the gas generator turbine drives the T64's optional reduction gearing through a coaxial output shaft within the turbine compressor shaft.

By adding or subtracting from this fairly conventional configuration, GE can use the T64 as a gas-generator, direct drive, turboshaft or turboprop engine. As V/STOL technology is refined and operators of piston-powered transports seek new economy through turbine conversions, the list of possible T64 applications can be expected to lengthen.

Possible Uses

To illustrate, the power output of the present T64 or a first-stage growth version probably brackets the power required by these vehicles, contemplated or in existence: a V/STOL transport for NATO in the 50,000 lb. gross weight category; the Boeing-Vertol HC-1B Chinook or a later cargo-assault helicopter such as the Sikorsky S-65 proposed for Navy or Marine use; a large flying


HELICOPTER, ROTOR
PITCH ACTUATOR
ROTOR BLADE ANGLE
COLLECTIVE PITCH LEVER
POWER
TURBOSHAFT PILOT CONTROLS
CONTROL LEVER
STARTING; SHUT OFF
FREE TURBINE SPEED
DROOP COMPENSATION AND ANTICIPATION (-2/-6 ONLY)
COMPRESSOR BLADE ANGLE
VARIABLE GEOMETRY ACTUATOR
FEEDBACK
VARIABLE GEOMETRY SCHEDULER
POWER TURBINE SPEED CONT.
Nf (-2/-6 ONLY)
FUEL TO ENG.
FLOW METER
MANIFOLD CONTROL, FILTER & DRAIN
FUEL MANIFOLDS & NOZZLES
GAS GENERATOR SPEED CONTROL; FUEL METERING VALVE
T3
P3
Ng
PRESSURE REGULATING VALVE
SHUT OFF VALVE
BYPASS FUEL
FUEL PUMP
ENGINE
POWER LEVER
STARTING; SHUT OFF; POWER
COORDINATOR
PROP SPEED SET; REVERSING; FEATHERING
CONDITION LEVER
FUEL PURIFIER
OVERSPEED SWITCH
Nf
ENGINE OIL
FUEL HEATER
TURBOPROP PILOT CONTROLS
REVERSING AND FEATHERING
PROP BLADE ANGLE
SPEED CONTROL
BLADE ANGLE ACTUATOR
BLADE ANGLE SIG.
PROPELLER
AIRCRAFT FUEL SYSTEM
OVERSPEED TEST-SWITCH

T64 MAIN FUEL CONTROL system is an interchangeable unit that can be used on both turboprop and turboshaft applications of the engine. Only cockpit controls need be changed. Pilot's main power lever modulates power turbine speed of turboshaft versions. Another control integrated with a collective pitch lever furnishes load anticipation and droop compensation. Turboprop also would have two controls to change propeller pitch and modulate engine power.

boat of the type requested by Navy; the Grumman SA-16 amphibian; the Hughes hot cycle helicopter with ducted rotor tips; the "mother transport" that emerges from Specific Operational Requirement 187; ground effect machines of many configurations; and a carrier-based ASW aircraft.

A less speculative application of the engine is the current GE-Grumman project to substitute T64-8 turboprops on a Gulfstream executive transport now powered by Rolls-Royce Darts. T64-powered Gulfstreams, according to GE, will be available as off-the-shelf aircraft late next year. In addition, Fairchild has proposed that Navy and the Air National Guard (AW July 10, p. 37) acquire F-27F or F-27G transports powered by T64s to replace Douglas DC-3s still in service.

GE intends to production qualify these basic versions of the T64, each of which initially will be rated at from 2,765 to 2,850 shp. or eshp. maximum power:

- **T64-6 direct drive engine.** The team of manufacturers selected to build the tri-service VTOL transport based their proposal on the T64-6, which has no reduction gearing, in order to gain greater design latitude. Output shaft rpm. of the T64-6 is 13,600 rpm.; its best specific fuel consumption, 0.495.
- **T64-2 turboshaft engine.** Addition of a spur gearbox to the T64-6 transforms it into the T64-2 turboshaft. Output shaft rpm. is reduced from 13,600 to 5,200 and the result is an engine capable of powering most large helicopters with the addition of further gearing selected by airframe manufacturers. T64's weight is 864 lb., as opposed to the T64-6's 713 lb.
- **T64-8 and -4 turboprop engines.** By bolting a planetary speed-decreaser gear to the -2 gearbox, GE turns turboshaft into a turboprop with a propeller rpm. of 1,160 at military power. Respectively, the T64-8 and -4 turn propellers offset either above or below engine centerline. Full power is available in reverse on both models.

GE engineers point out that high strength and rigidity in the T64's front compressor frame and casing were a must if the basic power unit was to turn a propeller. To get this strength and the flexibility it would afford, GE accepted a weight penalty. Partly as a result, power-to-weight ratio of the company's earlier T58 engine is better than that of the T64.

To give the T64 wide V/STOL applicability, GE designed it to operate normally at any angle between 45 deg. nose down and 100 deg. nose up. The engine probably would be inclined at 80-90 deg. just before the pilot of a tilt-wing, tri-service VTOL transport applied takeoff power.

If the T64 were to feature low specific fuel consumption (SFC equals pounds of fuel burned per horsepower hour) at part power, then it was probably a must that the engine incorporate a high pressure compressor. As a result, the T64's compressor pressure ratio of 12.6 to 1 is almost double the comparable ratio in the Pratt & Whitney JFTD12A-3 and Lycoming T53 and T55.

But efficient, high pressure, axial flow compressors involve multiple stages and thousands of blades—a combination that boosts engine cost and therefore limits commercial sales potential. GE solved this dilemma by mass-producing blades using the company-invented "roll and coin" method in which two cylindrical dies converge on cold metal, then rotate in synchronization to shape each blade.

GE also grouped coded, moment-weighted rotor blades in the rear stages of the compressor to minimize users' tooling costs. At the factory, moment-weight—a measurement of how the

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blade's mass is distributed internally—is inscribed on each of these blades. Replacement blades for user maintenance also have been moment-weighted and coded. As a result, a mechanic in the field can open the compressor's split casing and remove and replace faulty blades without disassembling the whole engine. He need not machine the new blades or rebalance the turbine stages, for this has been done in advance.

As GE's Small Engine Division keeps a close watch on the various military design competitions now under way or in the offing, its sales engineers are stressing these other T64 points:

- **Fast acceleration** from ground or flight idle power settings. GE has guaranteed Navy that acceleration to rated power can be achieved from ground idle in 20 sec. and from flight idle in 10 sec. By contrast, test runs indicate these times will be chopped by 50% to 75% on the average, for "typical" T64s now are accelerating from ground idle in about 5 sec. and from flight idle in about 3.25 sec. Variable inlet guide vanes and forward compressor stators enable this rapidity of response.
- **Free power turbine** with a wide, controllable speed range. During VTOL lift-offs, power turbine would develop its maximum speed of 17,000 rpm. During cruise, the power turbine could be slowed to as little as 12,000 rpm. without penalizing SFC prohibitively. Protection during high-power propeller reversals, or in the event overspeed warning signals fail, is supplied by an optional accessory.
- **Guarantees met** or surpassed in almost every instance. At this point, it seems certain that all versions of the engine will weigh from 5 to 15 lb. less than their latest guaranteed maximums. SFCs, moreover, are bettering GE's guarantees to Navy by even greater percentages. Engine power outputs, measured during official Preliminary Flight Rating Tests (PFRTs), equaled or exceeded those promised by the manufacturer. Unofficial 150-hr. qualification tests on one T64-6 engine showed its maximum power to be 3,125 shp. as opposed to the 2,850 shp. guaranteed.
- **Easy starting** with electric, hydraulic or pneumatic power. Drawn from ground sources, electric or hydraulic power would turn the first T64 compressor selected by the pilot of a multi-engine aircraft. After one engine is in operation, however, high pressure air can be ducted from its air impingement air manifold and applied to the turbine of another engine on the same aircraft. Or, all engines can be started by external power sources.
- **Simple, accessible** and interchangeable components. Wherever possible, commonly stocked bolts and nuts

T64 Development History and Timetable

Navy contract signed	April, 1957
First T64 ran	Aug., 1958
T64 tested with propeller	March, 1959
Turboshaft 50-hr. PFRT. approved	Aug., 1960
Turboprop 50-hr. PFRT. approved	Aug., 1961
Official 150-hr. qualification test (shaft) completed	Sept.-Oct., 1961
First formal flight test	Sept. 22, 1961
Turboprop 150-hr. QT. scheduled	Dec., 1961
FAA certification scheduled	June, 1962
Commercial T64s to be made available	Late 1962
Growth version (3,180 shp.) production qualified	Late 1964
Growth version (3,750 shp.) production qualified	Late 1966

secure major components to trim maintenance expenses. A fuel control that is identical on all T64 models—along with its pump, filter and accessory pad—is grouped centrally on the underside of the engine, attached by quick-disconnect clamps. The centrifugal fuel strainer is on the tank side of the fuel pump to guard against contamination in the field.

- **Rugged materials** and structure. Fire and especially corrosion damage are less likely to affect the T64 because it contains no magnesium. The percentage of steel alloys in the engine is high compared with that found in similar powerplants. For example, the split turbine casing, which covers both gas generator and power turbine, is made of steel as is the compressor casing. Maximum use has ben made of internal air and oil passages.

Engine Lubrication

Lubrication of the basic engine exclusive of reduction gearing stems from four main sources. Proceeding aft, the first is the front frame sump which contains the engine's gas generator and forward power-turbine forward seals and bearings, and the T64's radial accessory drive. Next is the main or mid-sump containing the thrust and rear gas generator bearings and seals. An exhaust-frame sump containing the power-turbine rear thrust bearing and seals feeds the power-turbine oil tube. This runs the entire length of the power-turbine shaft, lubricating by centrifugal feed.

At this stage, development of the T64 has been beset by only one major problem. GE contracted to run official 50-hr. PFRTs on its turboprop T64 in July, 1960. Not until 11 months later, in June of this year, were these tests completed. The turboprop T64's gearbox was responsible for almost the entire delay.

Hairline Cracks

After GE staged the first turboprop PFRTs in June and July, 1960, it discovered that hairline cracks had developed near the mounting of the reduction gear's rear housing. Navy dissatisfaction led the manufacturer to decide that a total redesign of the gearbox to meet more rigorous standards would be necessary.

During the next year, this redesign was carried out. The T64 reduction gear that resulted was inspected by Navy after a 50-hr. "penalty" run and given oral approval for flight in June 1961. One reason GE elected to use a turboprop T64, rather than a turboshaft, for first flight tests was its assumption that if any further problems did develop, they again would involve the engine's gearbox.

New T64 reduction gear incorporates a full three-point support system, gear

T64 Performance Ratings

T64-6 Direct Drive*

Rating	Minimum shp.	Output shaft rpm.	Maximum sfc.
10-min. maximum	2,850	13,600	0.495
30-min. military	2,690	13,600	0.499
Normal	2,270	13,600	0.522
75% normal	1,700	13,600	0.572
Ground idle	max. shp. 190	......	max. fuel flow: 345 lb./hr.

* Standard day, sea level, static ratings are at output shaft. Maximum allowable continuous output speed for T64-6 engine is 17,000 rpm.

T64-2 Turboshaft*

10-min. maximum	2,810	5,200	.502
30-min. military	2,650	5,200	.506
Normal	2,235	5,200	.530
75% normal	1,670	5,200	.582
Ground idle	max. shp. 185	......	max. fuel flow: 345 lb./hr.

* Maximum continuous output speed for T64-2 is 6,500 rpm.

Ideas you can use from

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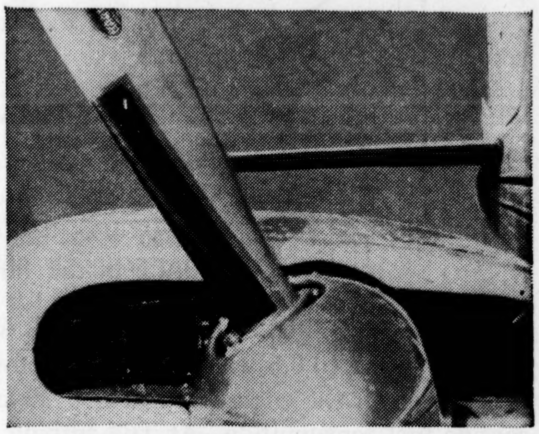

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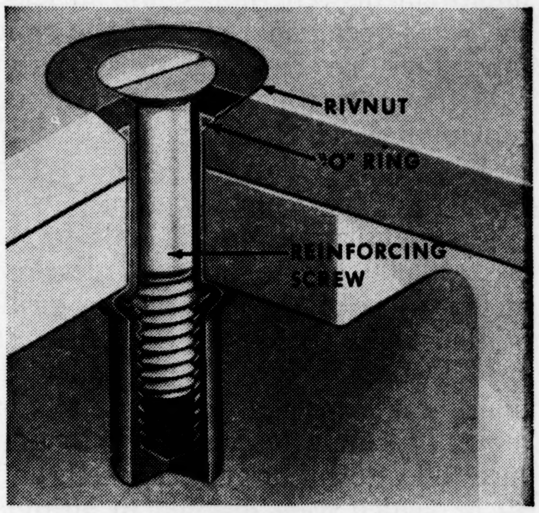

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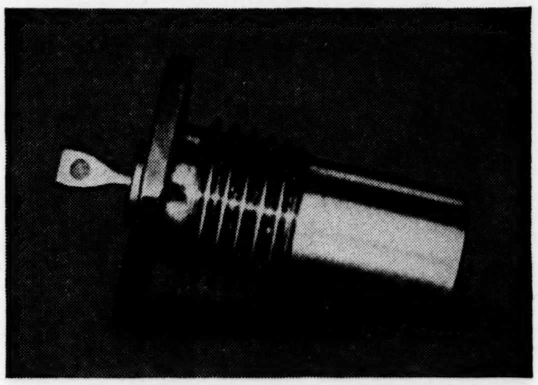

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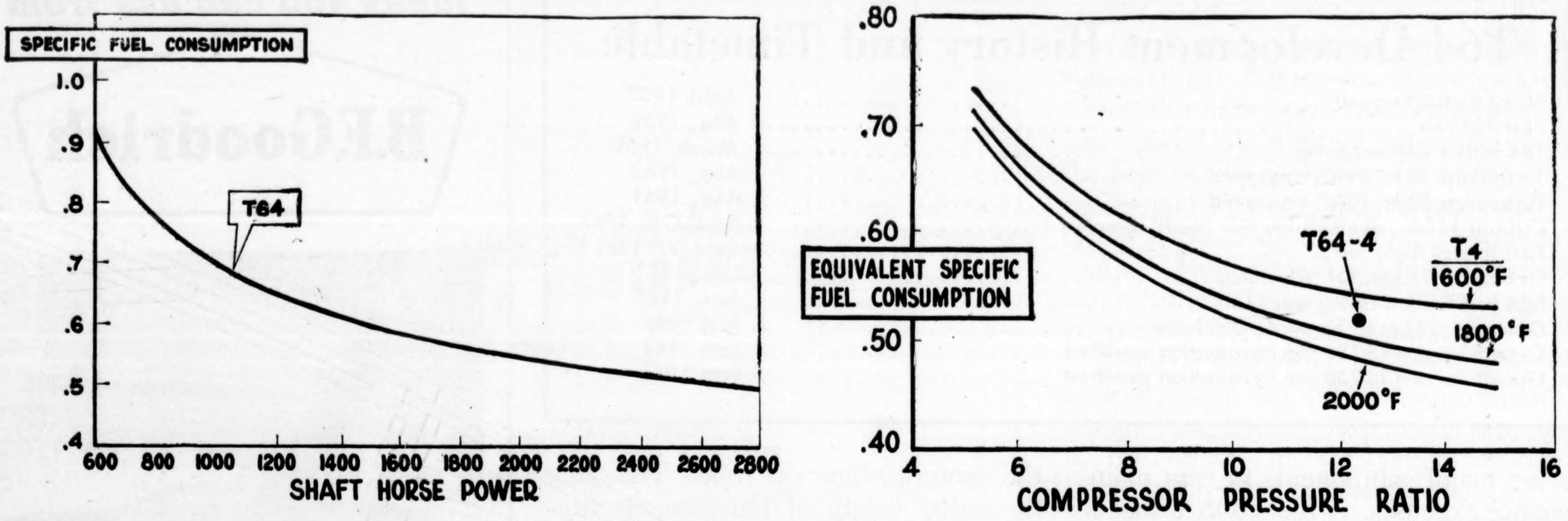
For more information check your B.F.Goodrich Aviation Representative, or write *Aviation Products, a division of The B.F.Goodrich Company, Dept. AW-100, Akron, Ohio.*



GENERAL ELECTRIC considers the T64's low specific fuel consumption the engine's outstanding characteristic. Note that SFC only rises from about 0.5 to 0.6 when shaft horse power is decreased from 2,800 to 1,500. Widely varying shp. outputs, from takeoff to cruise, have little effect on the engine's efficiency. Relatively high 12.6 pressure rise produced by the T64's 14-stage axial compressor results in low specific fuel consumption. At T64 turbine inlet temperatures (T_4), SFC does not rise as sharply as when engine power is reduced. Selection of the above compromise also enabled GE to avoid the sophisticated metallurgy required to achieve higher inlet temperature.

case walls of an increased thickness, a reinforced ring gear support, larger roller bearings for accessory drives and one-piece propeller shaft assembly. These improvements, GE hopes, will increase the gear's operational life. At the same time, they have resulted in a heavier reduction gear, which has boosted total turboprop weight from about 1,080 lb. to 1,136 lb.

Navy's development contract with GE is unusual because it calls for at least 10,000 engine hours of development testing prior to production qualification of all versions of the T64. At the end of August, 25 T64s had been built and subjected to 8,200 hr. of testing, including 4,100 hr. of endurance tests, 46 hr. of anti-icing tests and 89 hr. which were devoted to altitude tank tests.

Although GE has not revealed the amount of Navy money invested in T64 development, reliable industry sources say it is between $50 and $60 million.

First Tests

First official 150-hr. model tests of T64-2 and -6 engines were completed last month, but Navy's approval of the results had not been forwarded to GE by last week. The tests consisted of 25 six-hour cycles, each of which entailed continuous running of the engine at rapidly varying power levels ranging from maximum to flight idle. Next turboshaft model tests, scheduled for this month, will use Navy JP-5 instead of JP-4 fuel.

Altitude testing now is in progress at Navy's Aeronautical Engineering Laboratory facilities in Philadelphia. Engine operation has been rated satisfactory up to about 45,000 ft. at 1.1 ram pressure ratios. According to GE, windmilling restarts were accomplished at altitudes up to 30,000 ft. at 1.16 ram pressure ratio. Simulated cross-bleed starts using air ducted from one engine to another successfully were staged at 30,000 and 40,000 ft. with starter assistance.

According to guarantee, the T64 was to anti-ice 1.3 grams per cubic meter of water content at 5F and use no more than 2% of compressor bleed air in the process. In cold weather engine runs atop Mt. Washington (about 6,000 ft.) during the winters of 1959 and 1960, the engine actually anti-iced 2.1 grams per cubic meter of water content using only 0.7% of bleed air. Even at ground idle, GE reports, no ice accumulated.

Turboprop versions of the T64 have been bailed to Hamilton Standard Division of United Aircraft for 63E60 propeller compatibility testing. More than 1,300 hr. have been logged since these tests began in February. In addition, Navy has awarded Hamilton Standard a contract to design a tandem-blade, variable camber propeller to be used for T64s powering various STOL aircraft designs.

Despite this relationship between the two New England manufacturers, when Department of Defense announced that T64s would power the tri-service VTOL transport, it also indicated that Hiller rather than Hamilton Standard would be responsible for designing and building the new aircraft's 15-ft., four-blade propellers. Despite this responsibility, which will include engineering test work, many engineers at GE and Hamilton Standard believe that propeller production subcontracts will be awarded by Hiller to Hamilton Standard.

Flight Testing

Flight testing of the T64 officially got under way in Toronto, Can., on Sept. 22, when a Royal Canadian Air Force de Havilland Caribou completed a proving mission of slightly more than one hour (cover, AW Oct. 16). The flight, which was judged "satisfactory" by GE and de Havilland, took the Caribou to 12,000 ft. Two days earlier the T64-powered aircraft had completed a series of 14 lift-offs and landings, attaining an altitude of 100 ft. and an airspeed of 110 mph.

Its engines last week were being inspected.

Flight test programs involving Grumman S2F, Douglas DC-6 and Convair aircraft had been proposed to GE either by their respective manufacturers or Navy's Bureau of Weapons. However, the bureau decided against them largely for reasons of cost. When the Canadian government made available, at no cost, an aircraft of precisely the type best suited for the turboprop T64, and also offered to invest some money in the test program, Navy and GE accepted the offer. Cost of the RCAF de Havilland Caribou flight test program is expected to amount to less than half of the cost quoted by the next lowest bidder.

T64-4/-8 Turboprop Guarantees

Rating	Min. shp.	Min. net jet thrust	Min. eshp.	Prop shaft speed	Max. esfc.
10-min. maximum	2,765	210	2,850	1,160 rpm.	.490
30-min. military	2,570	200	2,650	1,160 rpm.	.500
Normal	2,245	175	2,315	1,015 rpm.	.512
75% normal	1,680	147	1,740	1,015 rpm.	.560

Mach 3 Fuel Combustion Hazard Foreseen

By Russell Hawkes

Los Angeles—Spontaneous combustion of fuels, lubricants, and hydraulic fluids by aerodynamic heating was predicted to be a significant hazard for Mach 3 transports by David D. Kurtovich and George E. Hays of The Boeing Co. at the National Aeronautic and Space Meeting of The Society of Automotive Engineers.

Kurtovich and Hays were reporting the results of 20,000 tests conducted at Boeing during the past three years. They found that the conventional understanding of spontaneous ignition as a vigorous reaction accompanied by a bright flame is incomplete in the special case of enclosed fluids aboard a supersonic transport. The experiments showed that a "cool" flame reaction also may occur and may produce lower, but still excessive and potentially damaging pressures. The lower reaction produces no visible flame, though a dim, blue glow is sometimes found to be present.

The intensity of the reaction depends on the pressure existing at the start of the reaction, the availability of the combustible mixture, and the ability of the volume space to contain the pressure that is developed by the reaction.

Various Tests

A variety of hydraulic fluids, lubricants, and fuels, including liquid hydrogen, was tested in heated pressure vessels of several sizes, but most attention was given to the conventional JP aircraft fuels.

Some of the tests were intended to show what pressure rise can be expected in a cool flame reaction.

Others measured the ability of chemical additives and dilution of the air volume over the fuel with inert gas to inhibit or suppress spontaneous reactions. Diluents tried included nitrogen, carbon dioxide and water vapor in quantities needed to reduce the oxygen content of the air space from a normal 21% to as little as one per cent. All were equally effective for a given volume. Water vapor offers the necessary volume for the least weight. Excess fuel vapor also acts as a diluent and at some temperatures acts as a chemical suppressant by entering into the combustion process.

Severity of Reaction

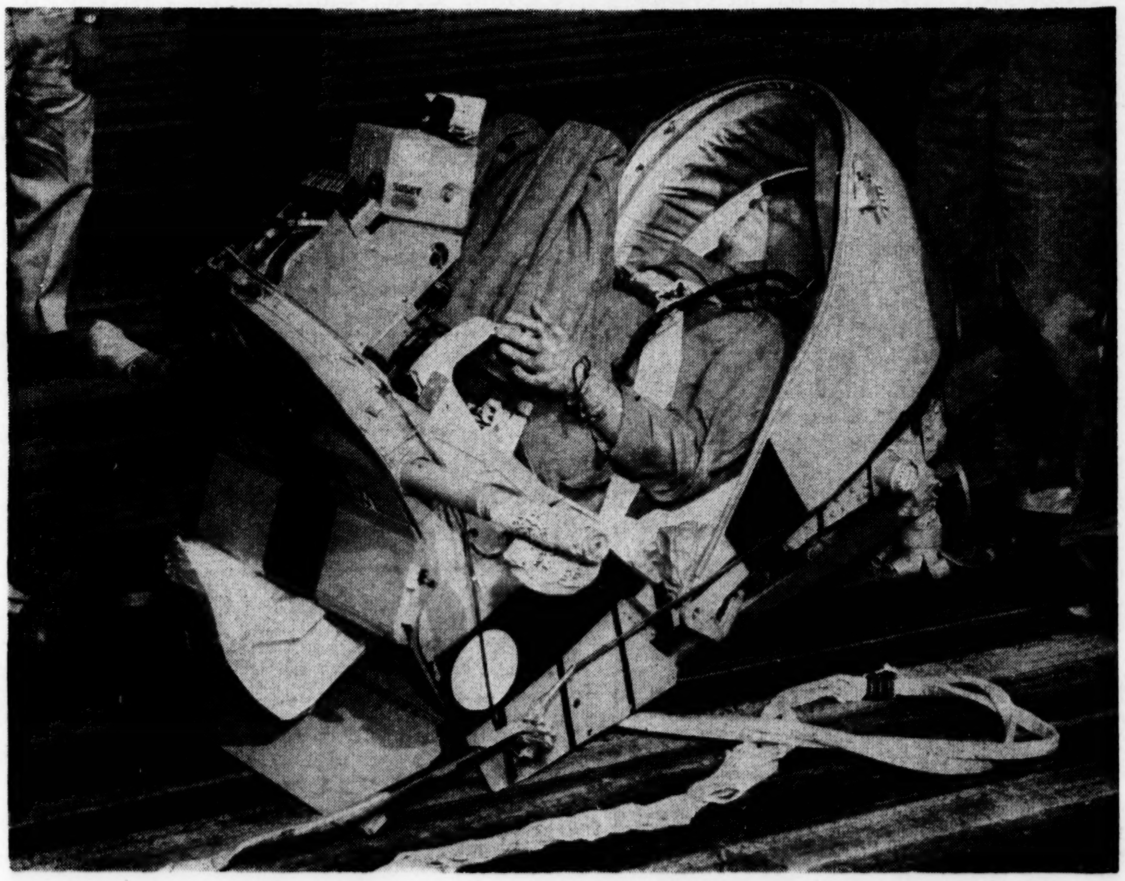
The severity of the reaction was found to be proportional to chamber volume up to one cubic foot, above which the reaction was not very responsive to size changes. Combustion products deposited on the chamber wall did not change the spontaneous ignition temperature of JP fuels in later tests but pressures were slightly lower than in tests in a clean chamber. Tests of hydraulic fluids showed different results. Combustion produced a gummy residue and chamber temperature had to be increased more than 100F or the interior walls had to be cleaned to get ignition.

There were indications that chemical additives which intervene actively in the combustion process inhibit the spontaneous reaction more than equal amounts of oxygen-displacing diluent. There are practical objectives to some of these because of handling hazards and corrosion. The additives tend to fall into groups with similar inhibiting properties. Within a group, different chemicals may have different fuel solubilities, vapor pressures and other properties that may be exploited. The best additive tested was tetra-isopropyl titanate which was developed by DuPont as an adherent wetting agent. Tests showed that with 0.25% of the total vapor composed of this, it was as effective as 70% nitrogen dilution in a 0.23 cu. ft. volume.

In a larger chamber the suppressing

B-58 Rocket-Powered Escape Capsule Tested

Rocket-powered escape capsule for the B-58 Hustler has passed an on-the-runway ejection test at Edwards AFB, Calif. Carrying a dummy crewman, the 700-lb. capsule, designed and built by Stanley Aviation Corp., Denver, Colo., to General Dynamics' specifications, was rocketed out of a B-58 traveling 115 mph. on the runway. Had a live crewman been in the capsule, he would have landed safely, officials said.



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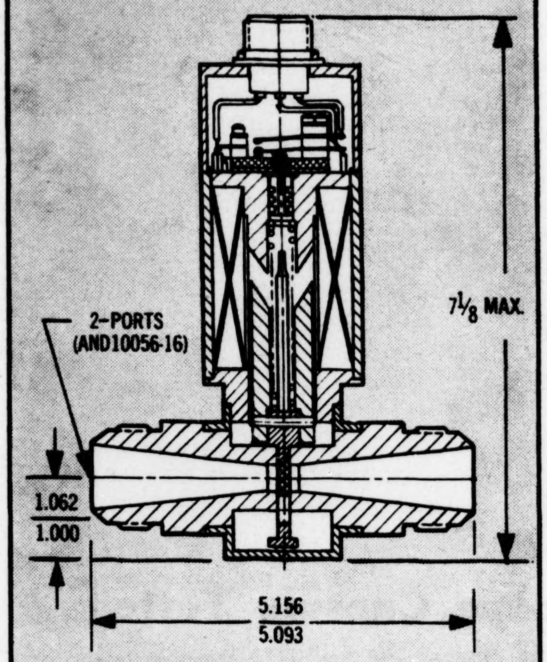

A direct-acting, high-flow, floating seal solenoid valve designed especially for cryogenic service! Valcor's unique Series V-41600 features an unusual leakproof design — all external joints inert arc-welded by special process. Flow of fluid media contacts only all-metal surfaces, avoiding cold-temperature shortcomings of non-metallic seals. BEST KNOWN DESIGN FOR LOW TEMPERATURE APPLICATIONS . . . Compression spring "snaps shut" the floating seal when the valve is deenergized for fail-safe action! Flow is equivalent to .850 diameter sharp edge orifice.

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characteristic was somewhat lower but still much greater than any offered by dilution.

Reduced atmospheric pressure at high altitude can be a practical protection against spontaneous combustion by reducing the oxygen partial pressure in the fuel space below critical values. However, prolonged supersonic flight will heat the fuel and it may be necessary to pressurize fuel spaces to prevent wasteful boil-off. Also, there would normally be an increase in tank pressure during a normal or emergency descent as gas is admitted to equalize internal pressure with atmospheric pressure.

These hazards must be countered either with a heavier structure to withstand collapsing pressures on unvented tanks or with an ignition suppressing system.

The authors said it is true that descent at the end of a supersonic cruise would usually be made at reduced speed and lower wall temperatures, but that thermal lag in heavy structure still might create a temperature high enough to produce spontaneous combustion.

Metal Fuel

Test runs of a research rocket burning the light metal, lithium, with hydrogen peroxide as the oxidizer were reported by M. C. Hardin, A. I. Masters and L. E. Toole of General Motors Corp.

The project had to solve three problems arising from the unfamiliarity of lithium as a propellant:

- **Pure lithium** cannot be handled like a conventional solid or liquid propellant. At room temperature it is a solid but it has a melting point of only 357F and has been routinely handled as a liquid. Only the Naval Ordnance Test Station, China Lake, Calif. has ever tried to use the molten metal as a fuel.
- **Very little is known** about combustion of lithium in rockets.
- **Thermodynamic data** for lithium combustion products is not complete enough to predict theoretical performance of lithium propellant systems and much of the existing data is questionable.

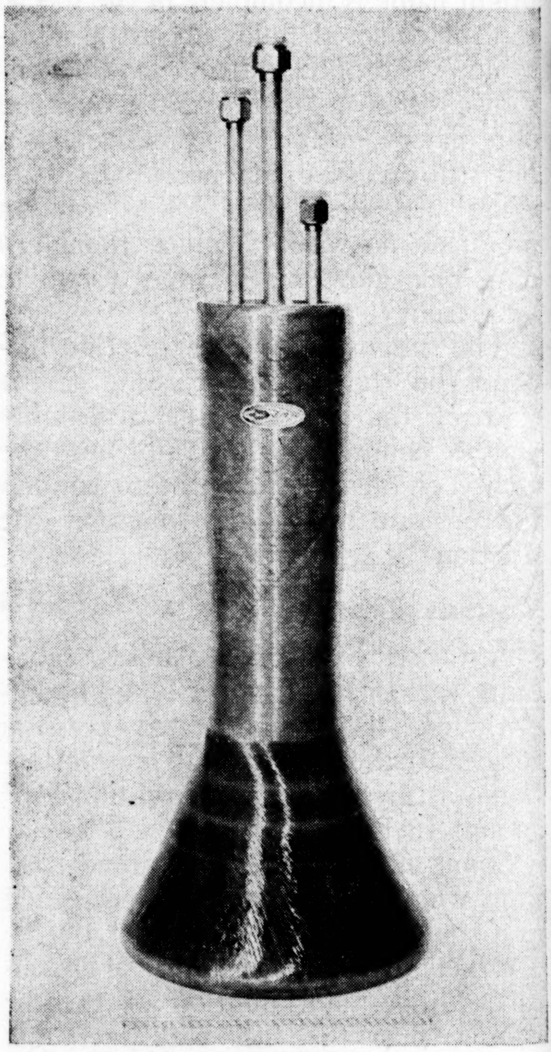
Lithium fuel for the test rocket was stored in a stainless steel supply tank in which the fuel was melted and heated to about 700F by surface resistance heaters. To keep the fuel temperature up to 600F during transfer to the thrust chamber, the stainless steel fuel lines were wrapped with Inconel resistance heating wire and insulated. Cartridge-type resistance heaters in copper heat sinks were used with the fuel valves. The fuel and oxidizer tanks were both pressurized to 1,000 psig. with argon gas.

Ignition of the test rocket begins with a period of monopropellant operation on hydrogen peroxide during which the fuel lines are purged with argon before injection of the molten lithium. At the end of the run both the lithium and the peroxide lines are flushed again. Argon was the inert gas selected because lithium and peroxide react with nitrogen and carbon dioxide.

Nozzle Erosion

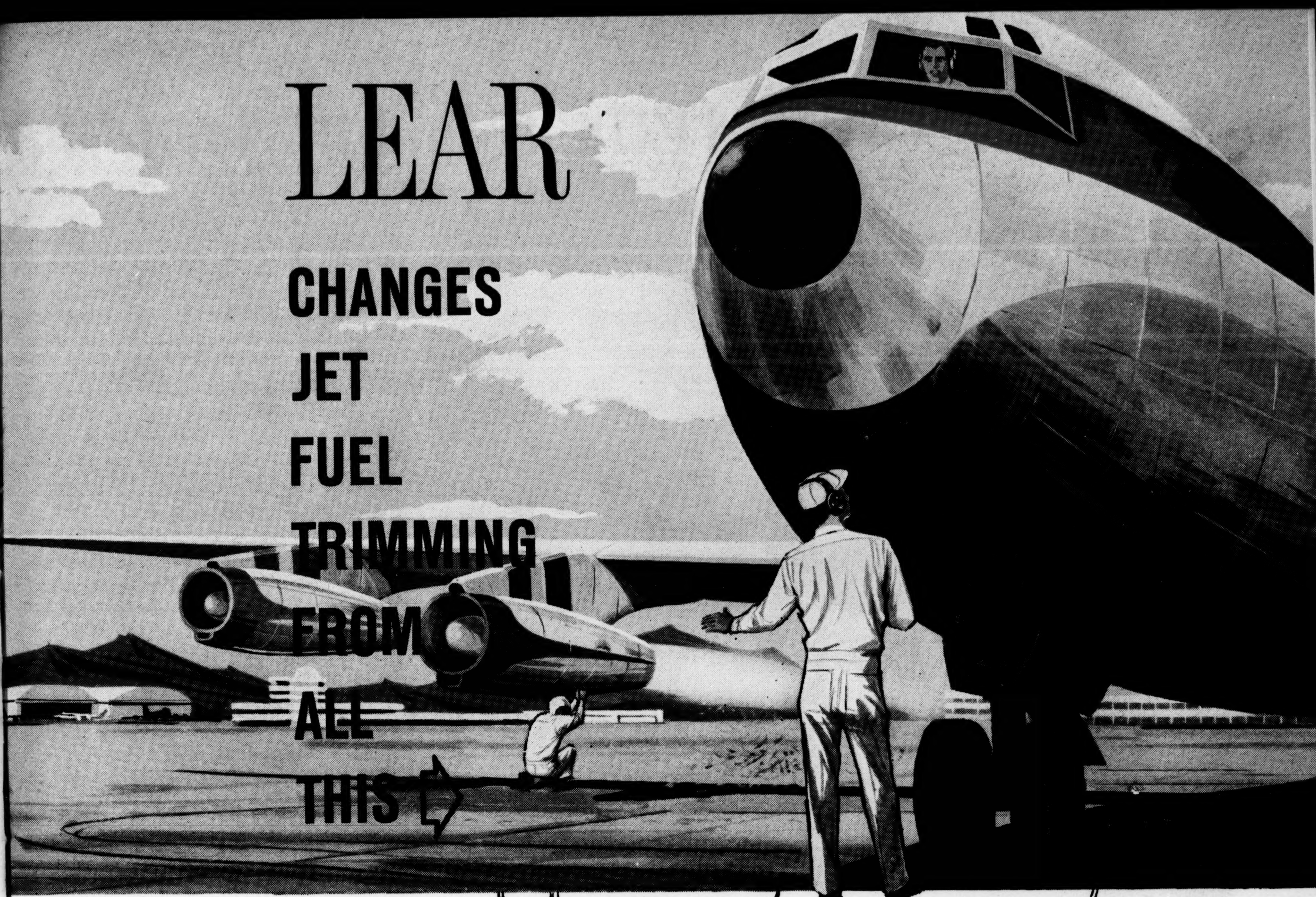
During 36 successful bipropellant runs, nozzle erosion was found to be a severe problem. The major factor causing the erosion appears to be unexpectedly high heat transfer rather than corrosion. This may be caused by condensation of lithium on the nozzle surfaces.

The highest specific impulse achieved during the tests was 247.



Ablative Chamber

United Technology Corp.-developed ablative-cooled thrust chamber for liquid fueled rocket engines has been used in continuous firing of a 2,200-lb. thrust engine for 4.5 min. The chamber achieved an accumulated duration of 7.2 min. with a re-firing. The chamber assembly, which can be used in engines of both low and moderately high thrust weighs 30 lb., requires no expensive turbine, and has restart and throttling capabilities. UTC says the assembly permits extended firing durations without sacrificing performance and thrust control and that changing nozzle dimensions can be predicted and controlled to acceptable limits. Chamber, assembly and exit cone total 28 in. in length. Exit cone is 13.05 in. in diameter at its widest point.



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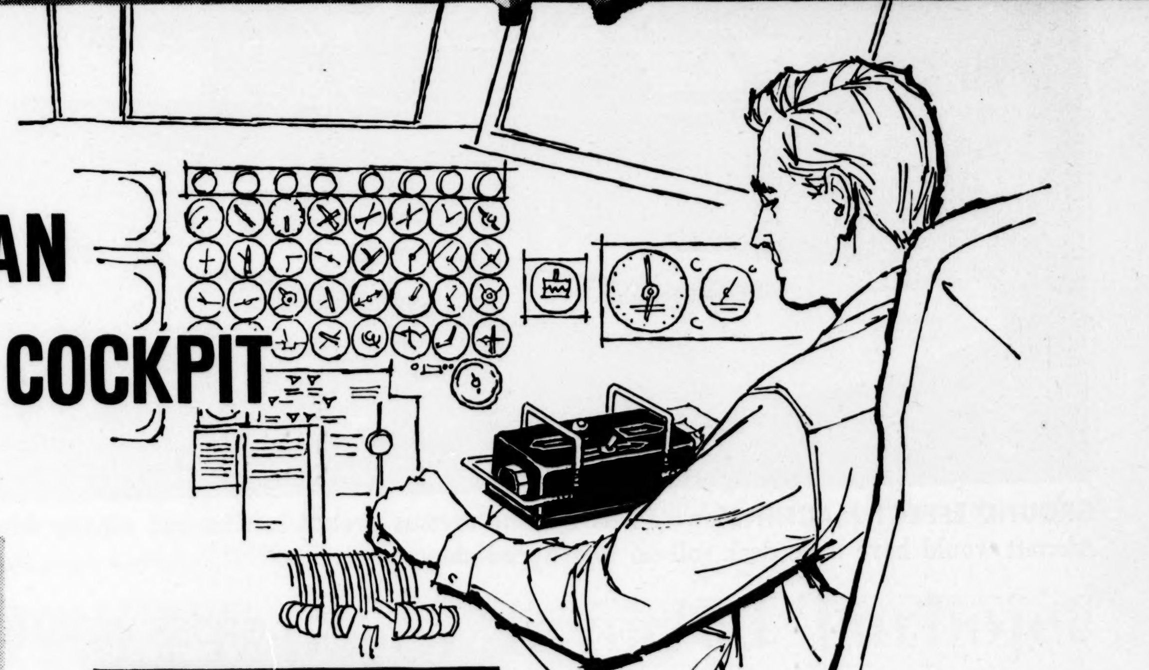
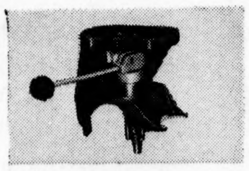
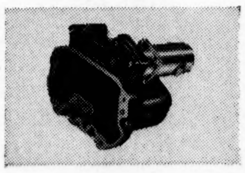


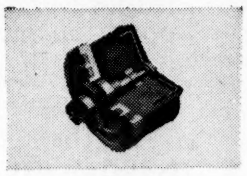
TO ONE MAN IN THE COCKPIT



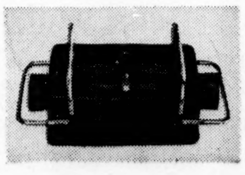
ADAPTERS—A simple clamp-on device that aligns automatically. Units are available for most combinations of engines and airframes.



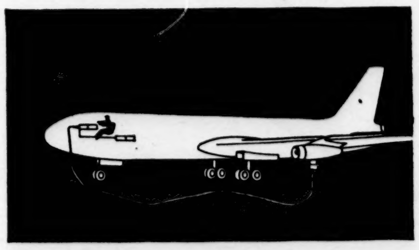
SERVO—Designed to be integral with the adapter, the servo utilizes a reversible DC motor and a highly accurate electro-magnetic brake to drive a series of LEAR magnetic particle clutches.



LEAR MAGNETIC CLUTCH—of advanced design and proved performance, the LEAR MAGNETIC CLUTCH is a key component in achieving the accuracy and reliability of the trimming system.



CONTROL BOX—A portable device, the control box is designed to be simple and easy to use. One man—in the cockpit—can rapidly make all adjustments—IDLE STOP, MILITARY POWER and WATER INJECTION.



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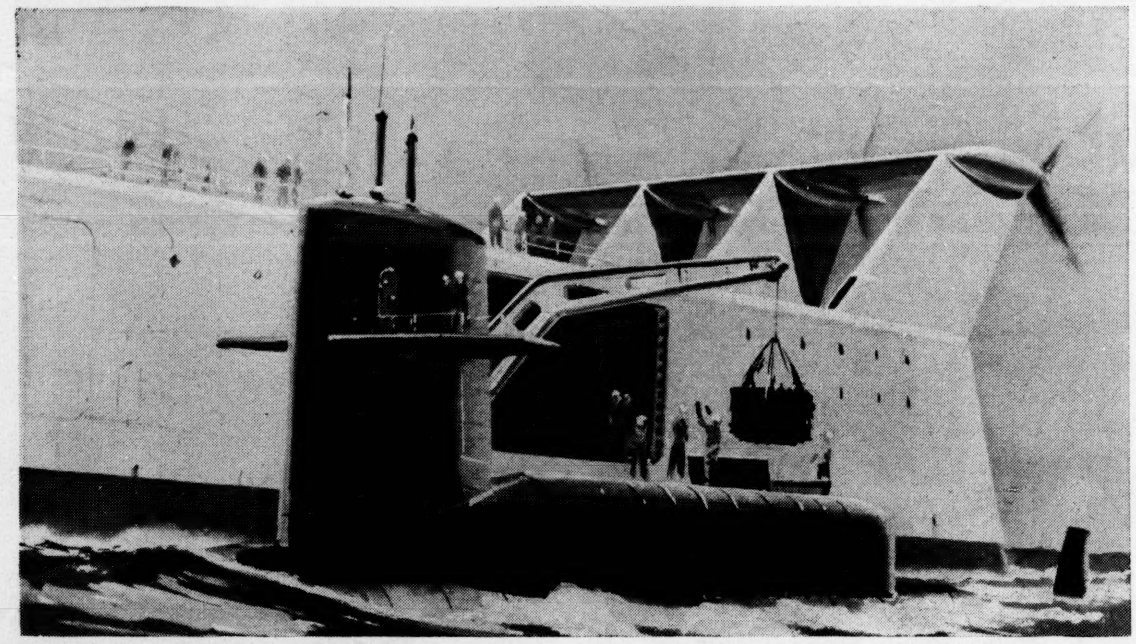
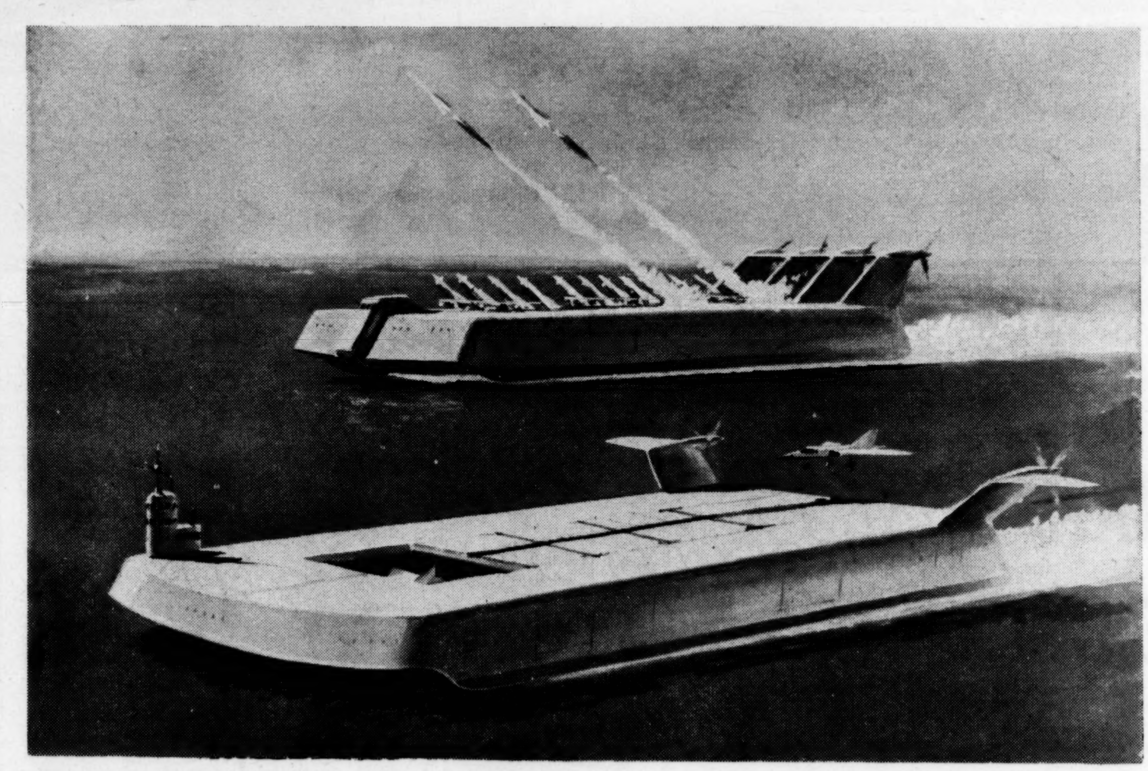
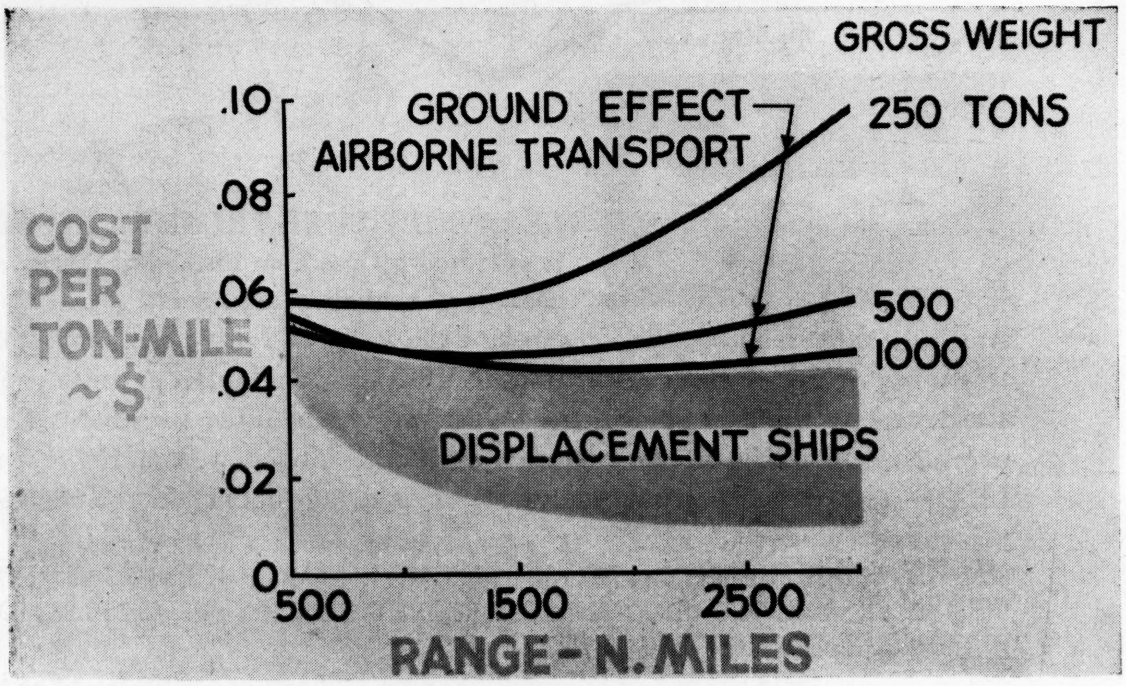
Sea-going Ground Effect Machine Ordered



DOUGLAS ARTIST'S CONCEPTION of large ground effect machine supply vehicle shows it re-supplying a Polaris submarine.



GROUND EFFECT MACHINES would have advantages as aircraft carriers and missile ships. Aircraft would have little deck roll on high speed ship.



VERY LARGE ground effect machines would offer approximately the same cost per ton mile as water-borne ships in addition to being up to four times as fast.

Contract for $370,000 to design and develop an ocean-going, cargo-carrying ground effect machine with a gross weight between 50 and 200 tons has been awarded to Vehicle Research Corp. of Pasadena, Calif. by the Maritime Administration of the U. S. Department of Commerce.

VRC is a small research company which has been working with Douglas on the operation.

Douglas Aircraft Co.'s Long Beach plant has been named major subcontractor and probably will manufacture the vehicle if the Maritime Administration decides to go ahead with construction at the end of the present development program. Detail engineering for a commercial test vehicle would begin in 1962. The present development contract is the latest phase in a cooperative program conducted by the Office of Naval Research and the Maritime Administration.

The proposed vehicle is being called a "surface effect ship" to add one more name to the already long list being used to designate vehicles designed to fly within ground effect. The prototype surface effect ship will be designed to operate over both water and land and will be able to climb beaches or ramps. Prototypes are expected to exceed the payload capacity of helicopters and fixed-wing aircraft of the same power.

The presently funded program will include extensive model tests to determine performance and operating characteristics in rough seas. When the development and preliminary design program establishes the most promising size between 50 and 200 tons, a ship of that size is supposed to be constructed.

A 100-ton surface effect ship would be about 142 ft. long, 76 ft. wide and would have a payload of about 46 tons. Engines developing 22,000 hp. would lift such a ship and propel it at over 100 kt.

In announcing the contract negotiations, acting Maritime Administrator Thomas E. Stakem mentioned potential use of surface effect ships in U. S. ocean, coastal and inland water transportation but the interest of the Navy in using the vehicles for military logistic missions is already well established.

At the recently concluded National Naval Aviation meeting jointly sponsored by the Navy and the Institute of Aerospace Sciences in San Diego, Calif., Douglas Aircraft Co. President Donald W. Douglas, Jr., described very large surface effect ships as the answer to fleet logistic support needs in the 1970 decade.

Douglas discussed surface effect cargo

ships with gross weights up to 1,000 tons. Their economic efficiency improves as their size is increased. They would tend to be broad and low in design and have very low planform loading pressure. According to Douglas studies, the bearing pressure would be about 0.25 psi. or 36 psf. With the entrapped low friction bubble of air supporting the ship, the thrust requirements for speeds up to 100 kt. are very low. This places it in a speed range between conventional water-borne ships and conventional aircraft. Douglas showed a chart indicating that the installed horsepower per ton of the surface effect ship lies in a direct line between that of large cargo aircraft and the more efficiently designed water-borne ships. While it is somewhat akin to the helicopter, it requires less than one-half the installed horsepower per ton because it has much greater efficiency operating within ground effect. Cost per ton-mile was shown to decrease with size up to 1,000 tons gross weight and to be minimized at longer ranges. Unlike the helicopter, it is not cargo-volume limited.

Douglas cited hydrofoil ships as promising competitors for the surface effect ship but said they appear to have technological limitations in the larger sizes. Unknown characteristics of the hydrofoil are its ability to operate in high seas and the effect of ice and debris in the water when foil-borne.

He claimed that the operation of the ships above the surface of the water gives them much improved security against submarine attack and cited the reduced cost of anti-submarine warfare protection as an economic advantage. Factors contributing to its invulnerability to submarine attack are:

- **Reduction of sound** transmitted through the water makes detection by the submarine more difficult.
- **High speed of the GEM** makes it a difficult target for torpedoes or other weapons.
- **Detonation of a torpedo** close enough to a GEM to destroy it is made difficult by the absence of any physical object beneath the surface.

Douglas listed some of the technical problems which Vehicle Research Corp. and Douglas Aircraft will have to solve during the Maritime Administration development program. It will be necessary to determine what shape the bottom of the surface effect ship should have to gain aerodynamic lift and yet respond safely to wave impact in heavy seas. Some design studies in the industry have indicated that such a large ocean-going vehicle might have a pure airfoil shape to maximize lift for the power expended, but Douglas said, "The rough-water sea-keeping capability is undoubtedly the foremost problem." Static and dynamic stability of GEMs still is the subject of some disagreement and Douglas predicted that significant efforts would be needed to establish the facts.

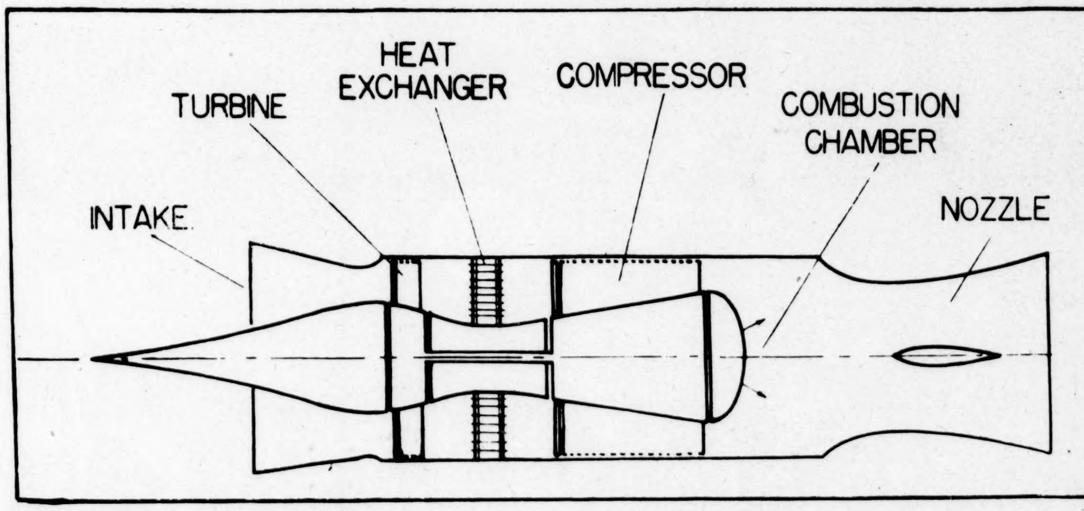
He said it would be desirable to develop larger engines, such as the "regenerative type combining aircraft lightweight technology with the operating economy of large stationary power plants." The usual naval and maritime problem of spray and corrosion will also have to be solved.

Possible applications for large surface effect ships in the 500 ton-plus class include Fleet Ballistic Missile Submarine resupply at sea. The near absence of subsurface noise would make it difficult for an enemy to track the cargo GEM to the rendezvous and destroy the submarine. As tankers, surface effect ships could refuel aircraft carriers and other fleet elements at sea on short notice. The combat ships would not have to slow down to match the pace of the tanker as they do while being refueled by a water-borne tanker.

Eventually, surface effect ships might be used as aircraft carriers, guided missile cruisers, and anti-submarine ships. Douglas observed that as the landing speed of carrier aircraft and the cruising speed of surface effect ships is about the same, aircraft being recovered would have little or no landing roll. The main deck handling problem would be holding the airplane down till it could be moved below decks.

Douglas studies indicate that operating altitudes of surface effect ships would be very low because they become more efficient and consume less fuel at lower altitudes. Those designed to travel long distances over land need higher operating altitudes to clear obstacles, but the primary interest of Douglas and Vehicle Research Corp. is the maritime and naval application including ship-to-shore operations in which the vehicle would replace lighters or landing craft.

Because of the relationship between operating efficiency and water clearance, the economy of the vehicles will be linked to sea conditions. "Analysis of the distribution of wave height occurrence in the oceans of the world indicates that a surface effect ship of 500 tons gross weight would be able to operate 50% of the time at a three-foot or less average altitude, closer when the sea is calm, higher and probably slower when it is rough," Douglas said.



SO-CALLED "inverted turbojet," envisioned by McGill University professor, shows heat exchanger between turbine and compressor systems.

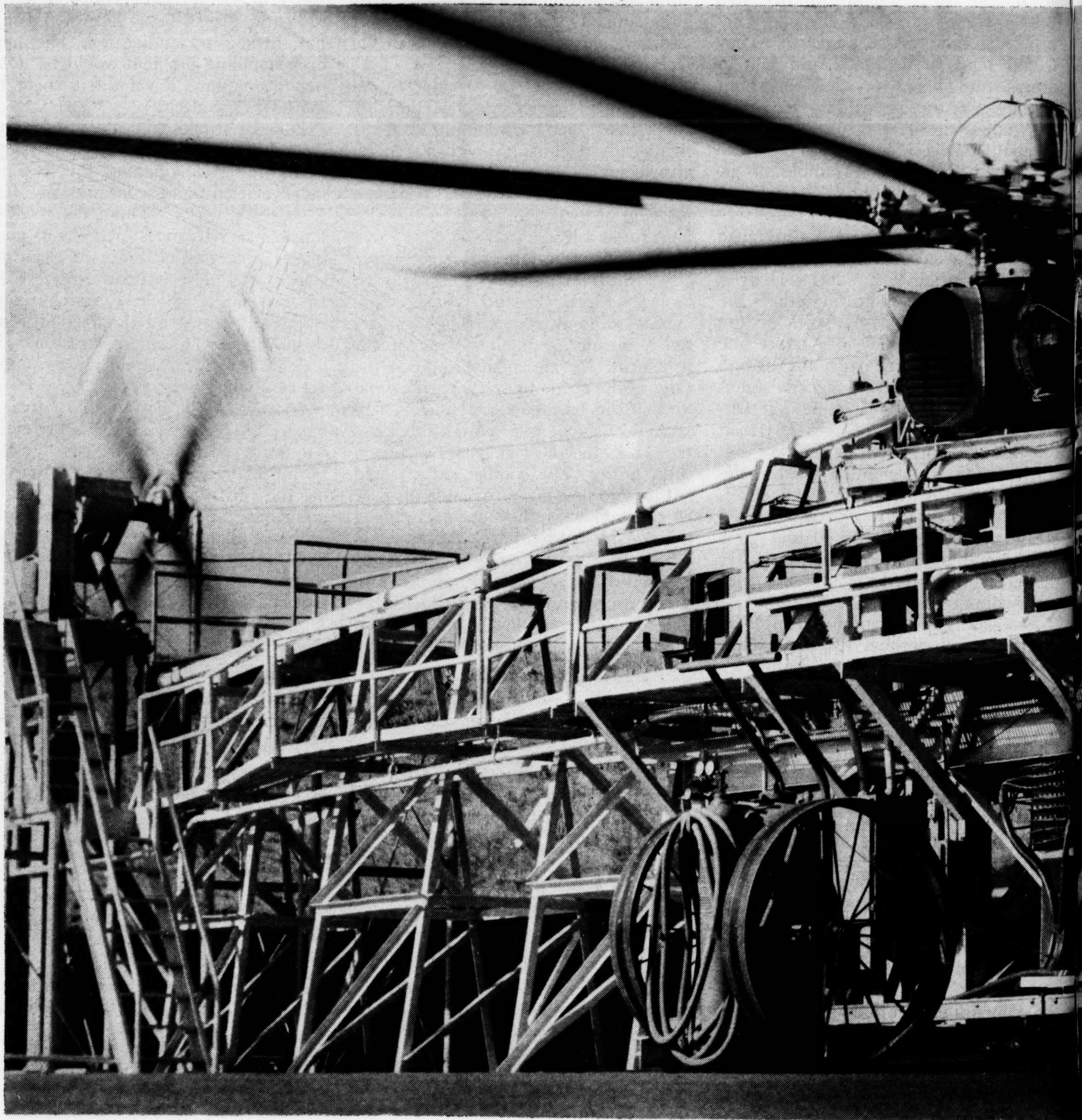
Trio Proposes 'Inverted Turbojet'

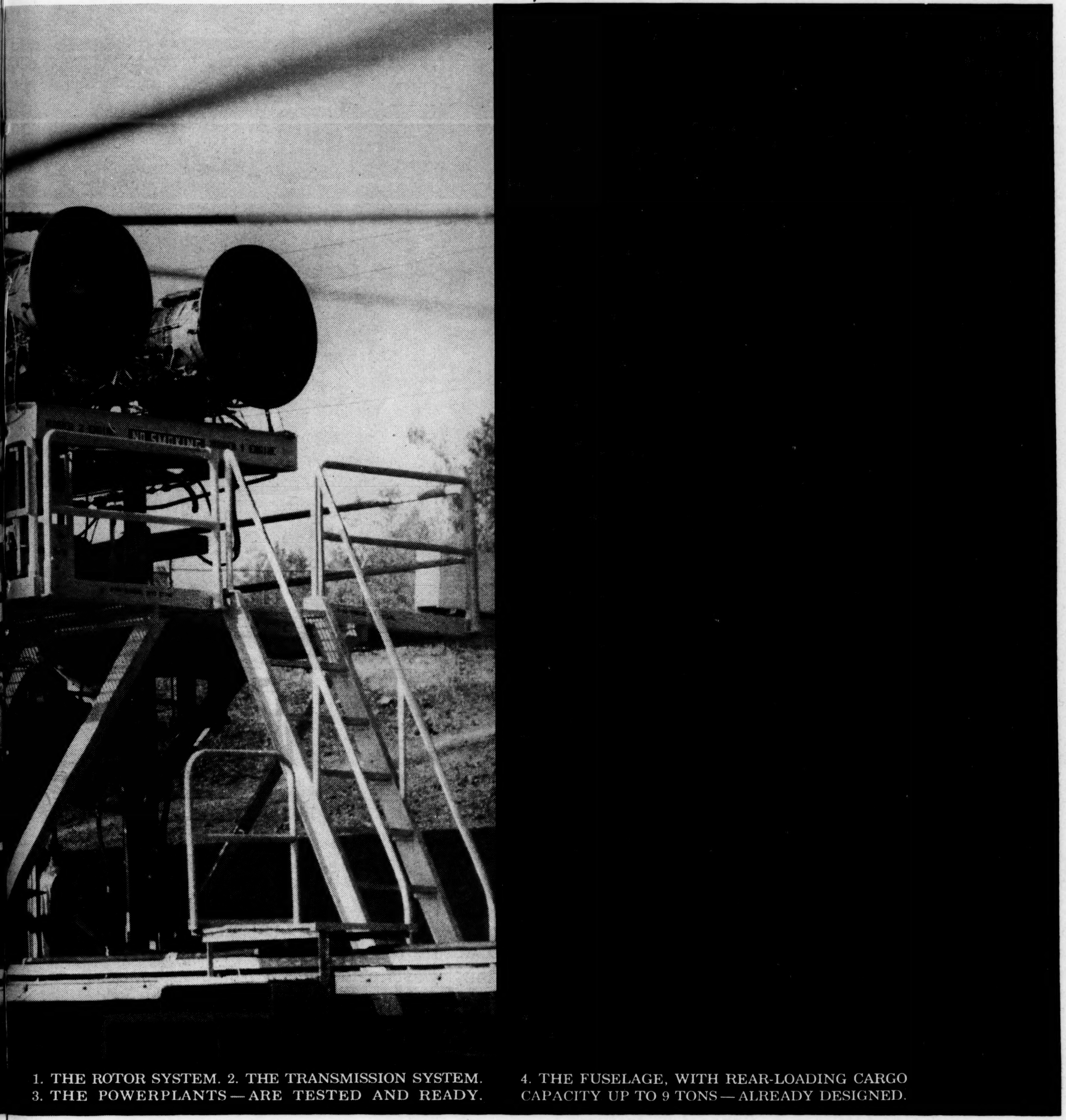
Unique turbine engine, called an "inverted turbojet" and capable of operating from Mach 0-6 range for a variety of missions, has been proposed by D. L. Mordell, dean of the faculty of engineering, McGill University, Montreal, in collaboration with F. W. Eyre, of Canadian Defense Research Board, and S. V. Sreenath, of the Indian Institute of Sciences, Bangalore.

Dean Mordell said the inverted turbojet interposes between the intake and main burner a turbine system, operating on the temperature difference between the intake air and a cold sink, which raises the pressure but lowers temperature of the air before reaching the main burner.

Fuel would be liquid methane; vaporized methane can be burned in the combustion chamber to produce about 105 lb. thrust per pound of air per second, with a specific impulse of about 1,800 sec. Ultimate fuel, Dean Mordell said, is liquid hydrogen, with a specific impulse almost double that of methane, or about 3,500 sec. specific thrusts of about 110 lb./lb./sec. can be obtained.

Dean Mordell emphasized that from preliminary studies it is evident that such an engine will be a "relatively poor performer at speeds below Mach 2 and indeed cannot compare with the turbojet engine at such speeds." But he said the main point is that the inverted turbojet can be run for checking systems and might supply some of the takeoff thrust, if necessary.





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This new ship will fit the close quarters of an aircraft carrier. It will deliver up to nine tons of weapons, supplies or what-have-you. It will fly faster than any other helicopter around. It will disgorge its load through a new high speed, heavy duty cargo handling system. And in combat, like past Sikorsky helicopters, it will also stand the test of battle.

The dynamic components, shown on test above, are ready. The new Sikorsky heavy assault transport helicopter can fill every known requirement—with plenty of power to spare.

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When time counts, it usually adds up to money! Profit-nibbling time lost.

In the case of pin and socket connections, add the uncertain reliability of other methods of terminating connections and you've got good reason to consider AMPin-cert* Connectors with crimped, snap-in contacts.

AMPin-cert tape-fed, pin and socket contacts are precision crimped to leads on the AMP* Automachine at rates of more than 1,600 per hour. High production rates, maximum reliability and low cost of semi-skilled labor combine with dependable connector performance for the lowest installed cost in the industry.

Make a simple, preliminary test. Check these AMPin-cert Connector features against whatever you're presently using:

- Compression crimping of leads to contact for maximum reliability backed by more than 20 years of AMP experience in solderless termination techniques
- Choice of five types of contacts
- Snap-in design contacts with cantilever beam construction for easy insertion and dependable retention forces
- Choice of phenolic or diallylphthalate housings with or without cadmium plated aluminum shells in standard or environmentally sealed designs
- Wide variety of configurations and sizes and complete line of matching hardware and accessories.

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AMP INCORPORATED

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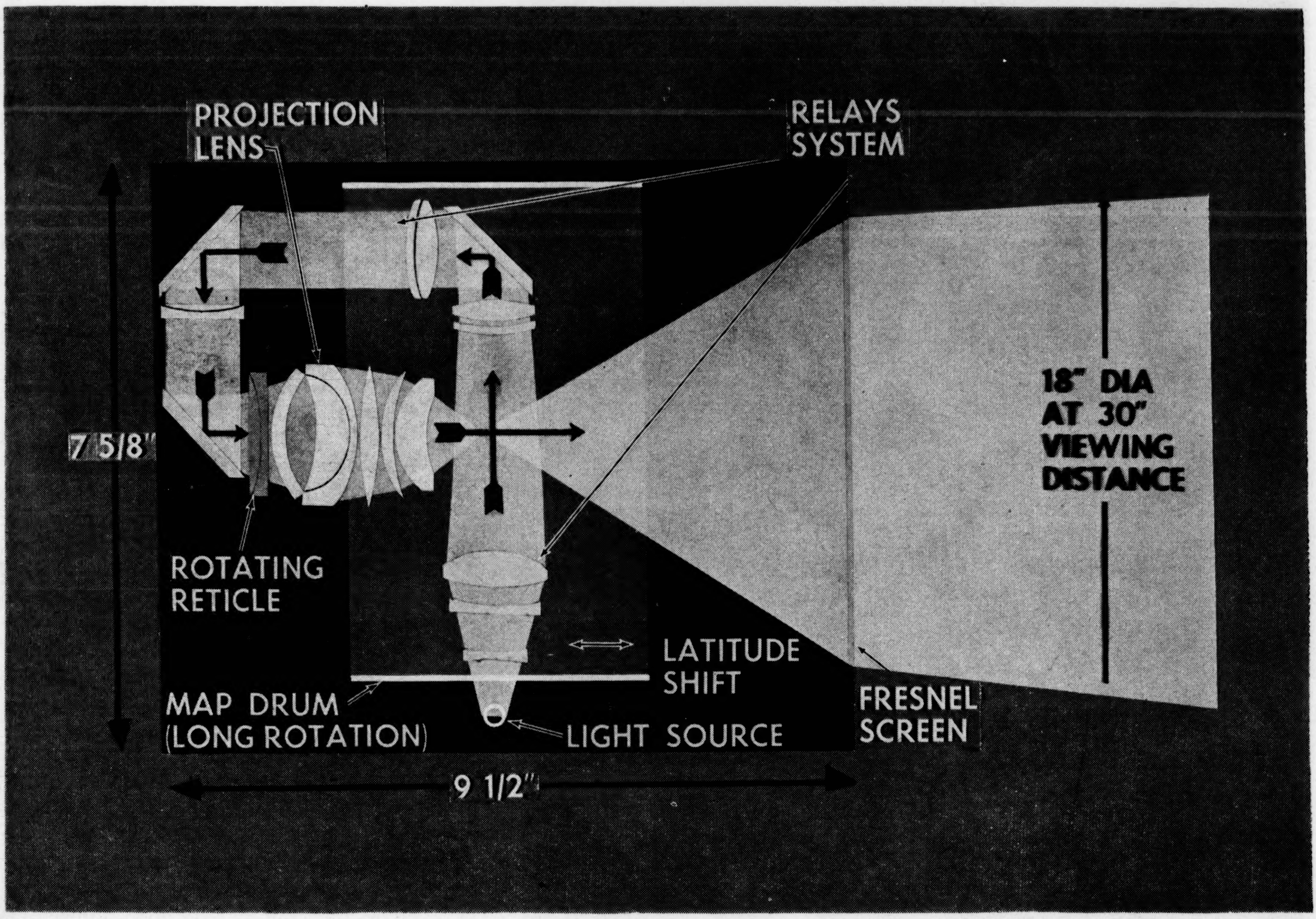


DIAGRAM of optical system of display indicates relation of the storage drum and the optics system, which had to be folded three times in order to permit it to be squeezed into the compact volume.

System Displays En Route, Terminal Data

By Barry Miller

Los Angeles—Compact cockpit pictorial display which can pinpoint aircraft position on en route maps as well as display terminal charts, emergency instructions and other flight information is being developed and refined here for the Air Force.

First model of this optical projection display was delivered to the Aeronautical Systems Division's Flight Control Laboratory earlier this year by its developers, Gilfillan Bros., Inc. The company will receive further support from the Flight Control Laboratory for the next step in the display's development—an effort to improve the display's readability.

The entire system, including the display, or picture situation indicator, a control unit, a data converter (containing amplifier circuitry, power supply and latitude conversion servo) weighs about 27 lb. The display itself is so packaged that it can squeeze within the prescribed depth dimension for the Air Force's Century Series aircraft. It runs about 9½ in. in depth with the screen projection accounting for about ½ in. of this figure. The screen itself measures 5½ x 7½ in.

System's Features

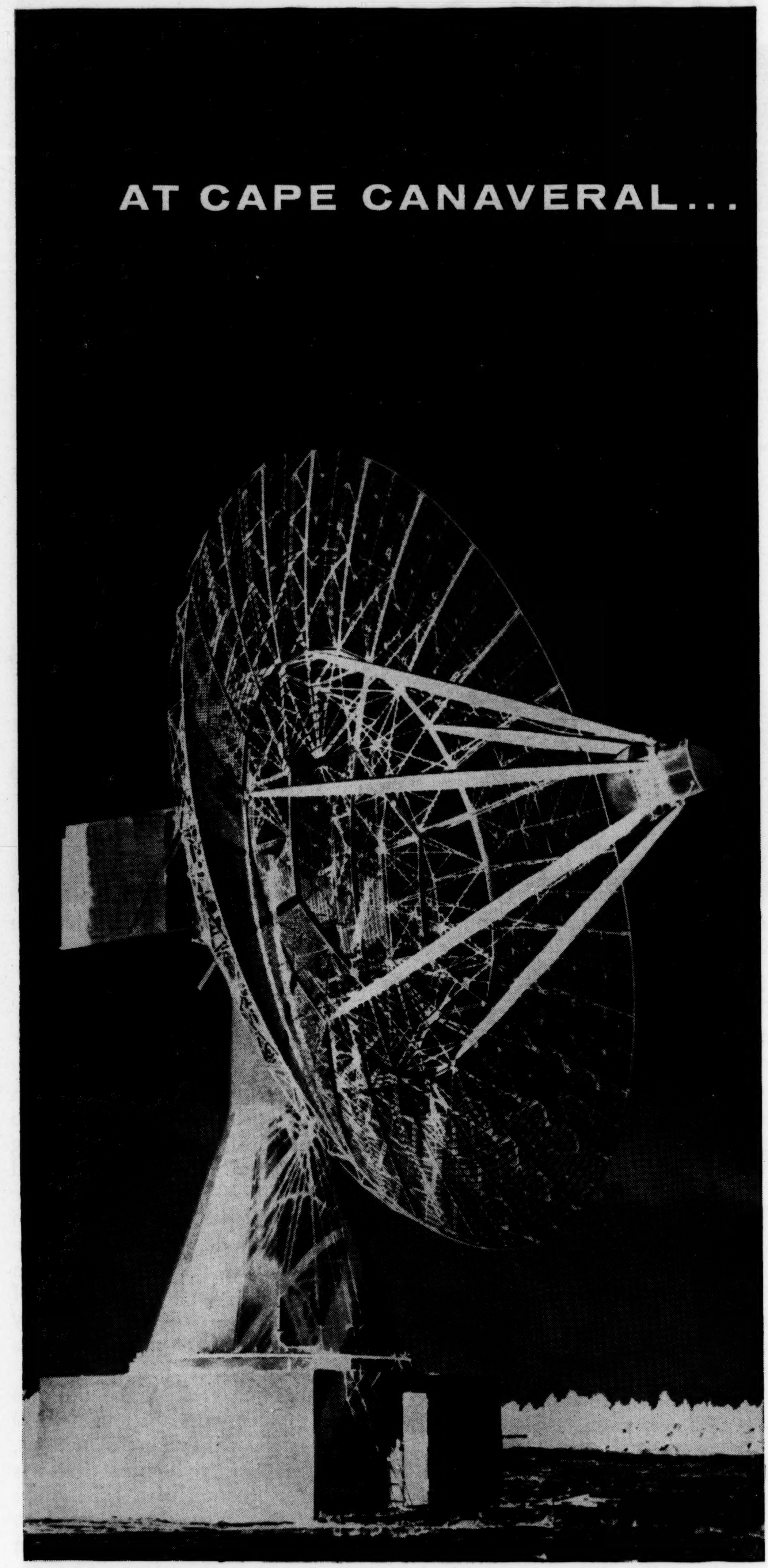
Chief features of the display, according to an Air Force civilian engineer monitoring the project, are its:

- **High density**—Relatively small size and weight and shallow depth, which make it a feasible volume/weight for particular aircraft applications.
- **Large storage area**—Information to be displayed is contained on a clear cylindrical drum on the inside periphery of which map or information transparencies are placed and optically projected onto the display screen. Useful storage area on the drum is approximately 75 to 80 sq. in., sufficient for sequential display of a wide variety of en route and terminal information. Transparencies containing necessary information can be removed from the drum and replaced by others. Access to the drum can be had by unscrewing and removing the display screen.

For demonstration purposes, Gilfillan has a standard Mercator navigation map of the United States in two adjoining strips, each about 3.2 in. in height and together about 19 in. in length, the total useful cylinder length. When in its automatic mode, the display automatically indicates aircraft position on this navigation map on the basis of navigational inputs supplied to it by a dead reckoning computer which is external to the display.

The remaining area on the drum is sufficient to accommodate roughly 300 frames of additional maps, instructions, etc. The map of the United States is a one-tenth reduction of a 1:2 million scale chart which can be enlarged to its original scale by a times 10 factor in the display's optical system. This enables the map to be projected at a size of about 30 naut. mi. per inch.

In typical operation as demonstrated recently, the system operates in several modes. During automatic mode operation, the position and heading of the aircraft, shown as an aircraft silhouette at the center of the screen over the



AT CAPE CANAVERAL...

Styroflex® Coaxial Cable

is a vital part of the Air Force Automatic-Tracking Antenna System!

The powerful TLM-18 telemetry antenna now in service at the Air Force Missile Center, Cape Canaveral, Fla., is used for the automatic tracking of missiles and earth satellites. This huge "mechanical ear," specifically designed by Radiation, Inc., Melbourne, Fla., has an effective data reception range of over 1000 miles.

One of the key parts of this highly sensitive device is the ⅞", 50 ohm, aluminum sheathed Styroflex® coaxial cable that links the 60-foot parabolic reflector to the receivers. The task of carrying missile-to-earth signals from the antenna to the control building demands a low-loss, high frequency cable with a high signal to noise ratio.

The remarkable characteristics of Styroflex® cable not only meet these rigid specifications but also have extra operational advantages, including long operating life under severe conditions and stable electrical properties during wide temperature variations.

Styroflex® coaxial cable has earned an outstanding record for these qualities in a variety of industrial, mass communication and telemetering applications. Perhaps this cable can answer your particular high frequency cable problem. We invite your inquiry.

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P
MINE TO MARKET
D

moving map background, appears continuously. The display is illuminated to a brightness of about 50 ft.-lamberts with a normal lens and about 150 ft.-lamberts if a Fresnel lens is employed. This illumination level can be turned down for night-time operation. (The brightness level of 50 or 150 ft.-lamberts compares with a brightness of 12 to 15 ft.-lamberts for a typical movie screen, according to Gilfillan engineers.)

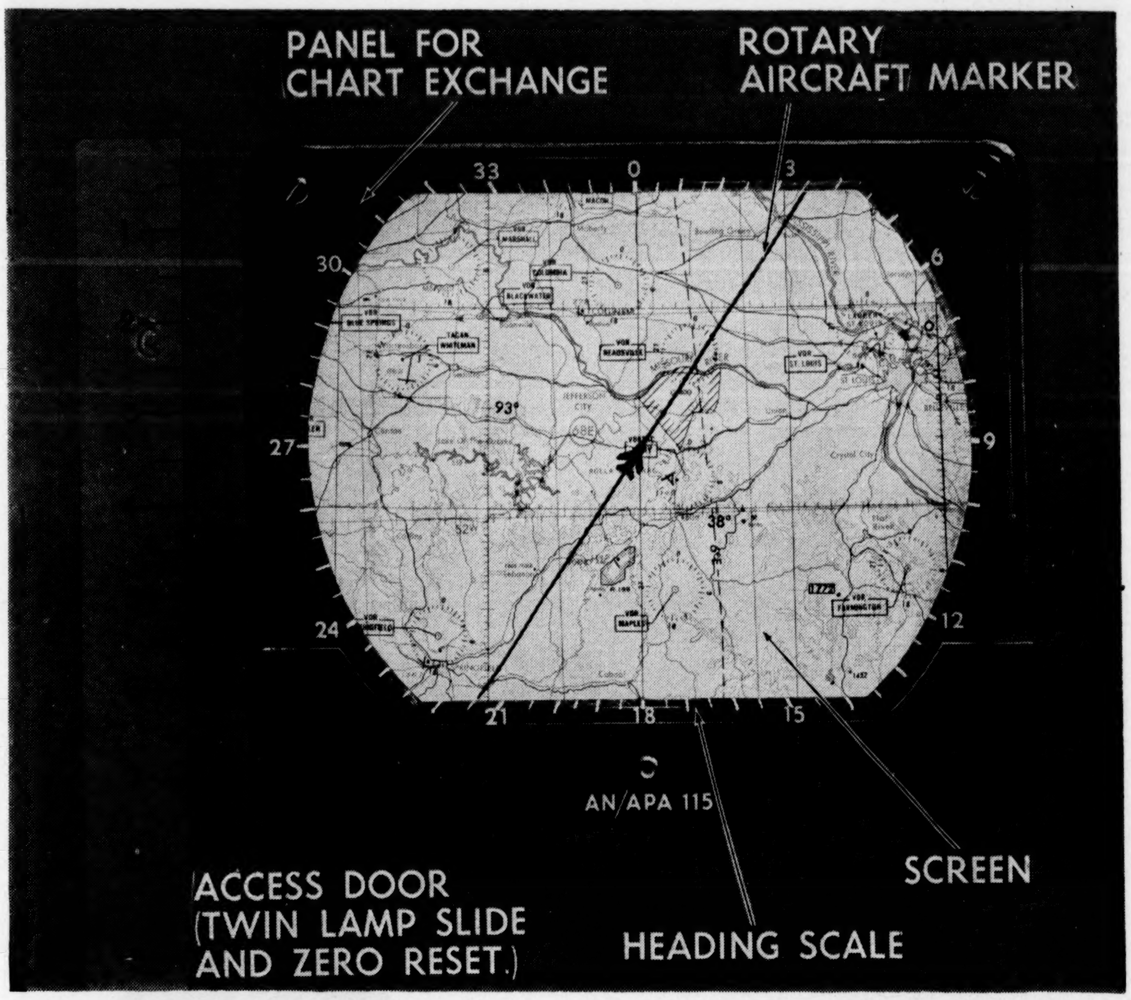
Navigational data such as latitude, longitude and course are supplied to the display by navigational devices such as a dead reckoning computer in the present system, or inertial systems.

The display was built to an Air Force specification requiring that it be accurate to within three nautical miles between any two points in the United States, assuming perfect inputs. When navigational fixes are obtained, the pilot can manually readjust the display by offsetting the zero point in both latitude and longitude. He does this by turning two easily accessible differential transformer controls. This operation could be automated, Gilfillan says, although the firm has not attempted to do it with the first two models.

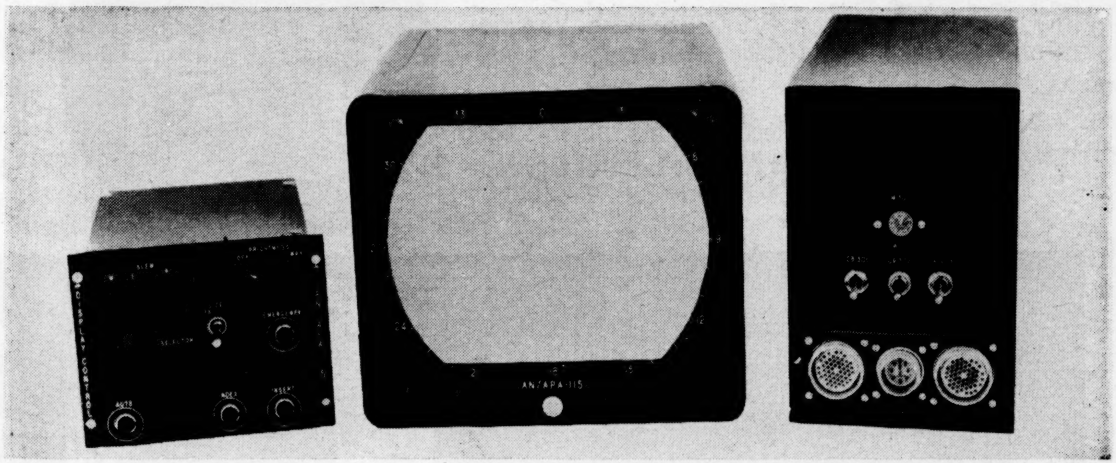
By depressing an index button on the control unit, the pilot obtains an index of the contents of additional information (besides the en route map) stored on the display's drum. Each item is coded, and after locating the particular frames he desires, he selects the corresponding code on two adjacent finger code wheels. He then depresses an insert button, which causes the controls to slew to the proper map or chart. Information such as terminal plates, ground control approach instructions and en route high altitude charts are typical of what could be stored. Quick access information can be obtained in a maximum of two seconds.

The control unit also contains an emergency button which can bring about the display of emergency instructions reproduced from the aircraft's flight manual. Also on the panel are slewing controls which enable the pilot to slew over the maps (taking the display out of the automatic mode) and view a specific portion of the map. The system will slew between any two points on the Mercator map in 10 sec.

The pilot can also toggle select between a 10 and 30 times enlargement of the stored data. The former results in the 1:2 million scale mentioned for the Mercator map, while the latter (giving a 1 to 666,666 scale for the Mercator map) would be used largely on terminal charts.



AIRCRAFT POSITION and heading can be pinpointed against moving background map.



GILFILLAN BROS. system includes control unit (left), display and data converter.

The main goal of a new contract Gilfillan will receive shortly from Flight Control Laboratory revolves around an improvement in the display's optics, resolution and in photographic transparency quality which would all combine to make a more readable display.

Resolution charts placed in the present models indicate that about 50 lines per mm. presently can be resolved optically. Photographic resolution, company engineers say, needs to be improved, especially because photographic image deteriorates at 30 power.

In the display, the desired transparencies are mounted on a moving drum, whose axis of rotation is normal to the screen. The map is illuminated from the bottom of the display by a General Electric iodine wing-tip lamp which can be inserted and removed from the display in a reversible, double cartridge. The image is "relayed" by an optical system consisting of mirrors which result in folding the image three times. This produces an intermediate image centered behind the screen, at right angles to the map. Located at this intermediate point is a reticle with an aircraft engraved on it and mounted on a cradle that rotates in synchronism with the heading output from the display's input—in this case, a dead reckoning computer. The projection lens, situated between a reticle and the screen produces a shadow image of a rotating aircraft over the moving map.

To change longitude the drum rotates since its rotation is slaved to the longitude output of the computer when in the automatic mode. The rotation of the aircraft reticle is slaved to the heading output of the computer.

Latitude output of the computer must first be converted because a Mercator map (rectangular map) was used in this case. The scale change, proportional to the secant of the latitude angle, is computed by a servo employing a non-linear potentiometer which feeds another servo. This rotates a lead screw thereby moving the drum back and forth corresponding to latitude changes.

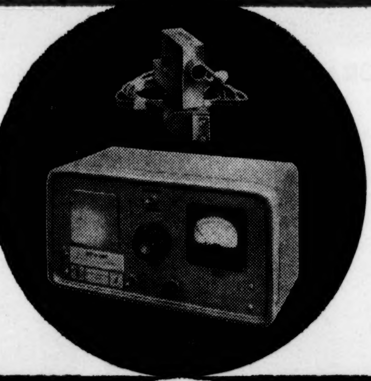
Gilfillan is planning a number of design changes in future versions of this display. One of these envisions use of a Hughes Tonotron tube for an electronic reticle.

The areas of interest of the Giannini Scientific Companies encompass a wide range of the technical spectrum. Each of the companies is independently managed, under the guidance and long range planning of the parent company.

The Giannini Scientific Companies

Flight Research, Inc.
Richmond, Virginia.

Photographic Data Recording Instruments and Accessories, Business Aircraft Control Devices.



Flight Research's Autolume* Light Intensity Controller is used in document microfilming. The completely electronic Autolume senses the reflectance of the document and automatically adjusts the brilliance of the flood lamps to produce a negative with a predetermined background density.

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Micro-Balancing, Inc.
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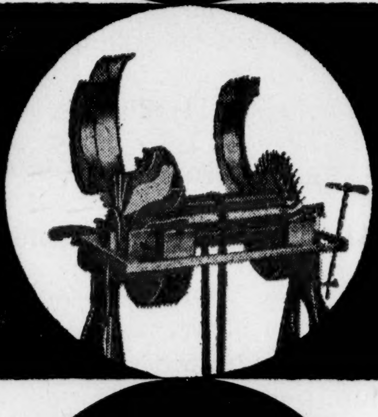
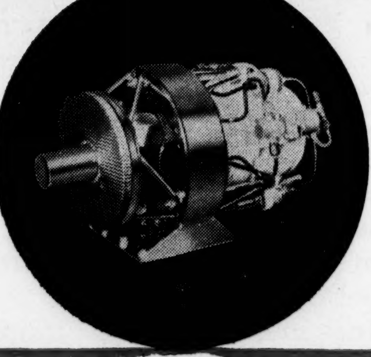
Dynamic Balancing Equipment, Photo Electric Switches, Cable Analyzers.



Micro-Balancing's Dynamic Balancers quickly locate position of unbalance and determine its magnitude in turbines, impellers, aircraft accessories, armatures, pulleys, drums and other components requiring smooth rotation.

Plasmadyne Corporation
Santa Ana, California

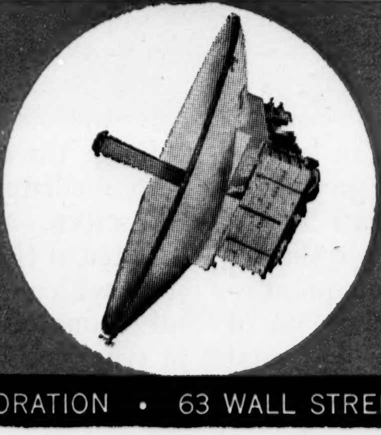
Space Propulsors, Hyperthermal Tunnels, Plasma Spraying Devices.



Plasmadyne's Thermal Arc Jet Engine for satellite attitude control and micro-orbit adjustment was developed for NASA under the auspices of the Marshall Space Flight Center. The engine measures only 12½″ long by 8½″ dia.

Wiley Electronics Company
Phoenix, Arizona

Microwave Radiometry, Ranging and Detection Systems and Components.



Lightweight, compact Wiley Radar Altimeter, has been qualified for inclusion in space vehicles and satellites. Complete radar system, antenna, battery and power supply, weighs less than 6 lb.

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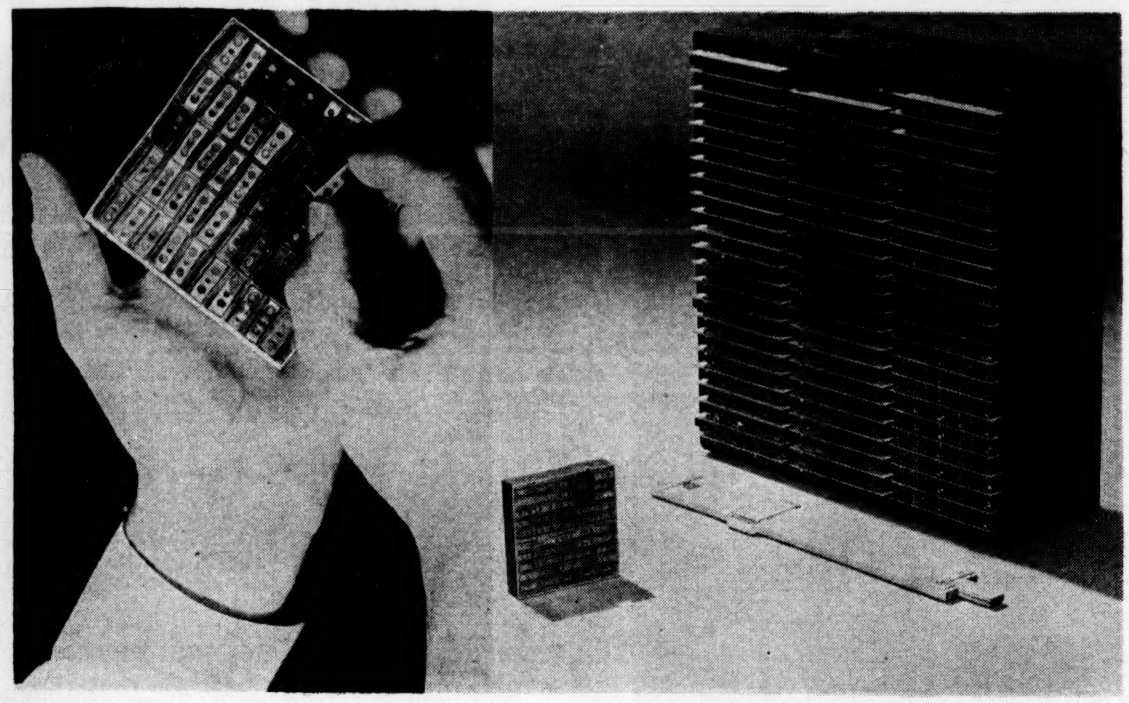


MICRO-MINIATURE digital computer, occupying only 6.3 cu. in. and weighing only 10 oz., is constructed from solid-state circuitry fabricated on a single silicon crystal by Texas Instruments. Computer with equivalent performance, built with conventional miniature components, is shown alongside new computer to demonstrate size reduction.

Solid-State Circuits Used to Build 10 oz. General Purpose Computer

New line of micro-miniature solid-state circuitry, available in six different types of digital computer functions, each measuring only $\frac{1}{4}$ x $\frac{1}{8}$ x $\frac{1}{32}$ in., capable of handling 90% of the circuit functions of digital computers, has been announced by Texas Instruments, Inc.

Company is expected soon to announce the availability of another series of analog type solid-state circuits. These will include a low level audio amplifier, a d.c. differential amplifier, a video amplifier and a 3-watt power amplifier.

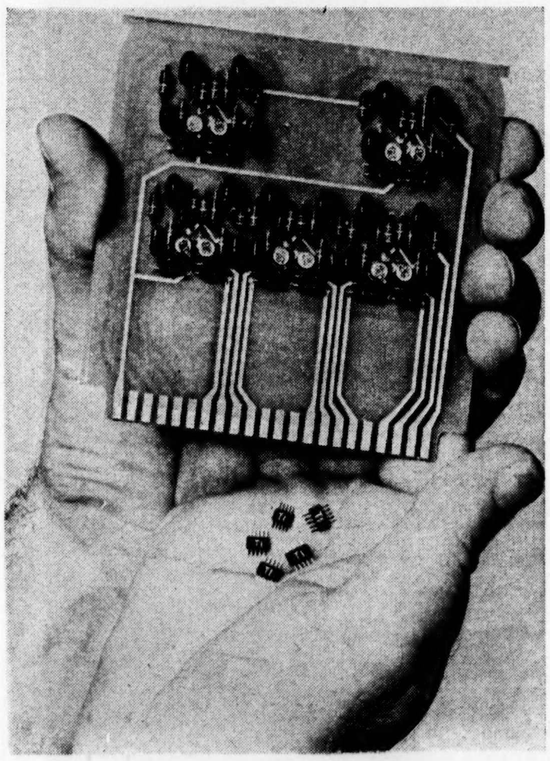
The new solid-state circuits have been used to construct a general purpose digital computer weighing only 10 oz. and occupying only 6.3 cu. in., under the sponsorship of the Aeronautical Systems Division's Electronic Technology Laboratory (AW Oct. 23, p. 30). A computer with equivalent performance, built with conventional miniature components, weighs 480 oz. and occupies 1,000 cu. in., the company said.

The micro-miniature computer is a serial binary fixed-point machine with an operand word length of 10 bits plus sign. Machine uses synchronous logic operating at a 100-kc. clock rate. Total power dissipation is 16 watts.

The computer consists of 47 plug-in modules, each consisting of eight to 16 solid-state circuits welded into a stack and then encapsulated. Each module weighs approximately 0.04 oz. and occupies approximately 0.057 cu. in. The micro-miniature computer contains a total of 587 individual solid-state circuits. Equivalent computer built from standard components would have a total component count of approximately 8,500, according to Texas Instruments, Inc.

The new Series 51 line of solid-state circuits, each fabricated on a single silicon wafer with vacuum deposited interconnections, oxide coated and encapsulated for environment protection, is available in the following types of functions:

- **SN-510, SN-511:** flip-flop/counter.
- **SN-512, SN-513:** NOR/NAND gates.
- **SN-514:** Two independent NOR/NAND gates.
- **SN-515:** Exclusive OR gate network.



SOLID-STATE circuit built on silicon wafer, first developed 2½ years ago (AW Mar. 30, 1959, p. 33), is now available in six different computer functions.

Both the SN-511 and the SN-513 have emitter follower outputs in addition to regular outputs to provide higher driving capability for succeeding logic stages. The devices are designed to operate over a temperature range of −55C to 125C.

Prices for the Series 51 solid-state circuits range from $50-$65 in quantities of 1,000 to $76-$115 in small sample quantities.

FILTER CENTER

▶ **TRW Subsidiaries Merge**—Pacific Semiconductors, Inc., a subsidiary of Thompson Ramo Wooldridge and TRW Components Co., a combination of various TRW component subsidiaries and divisions, are integrating their operations in the initial phase of merging both groups into a single organization, probably to be known as PSI Electronics Corp. The move is regarded as an effort to bolster Pacific's position in the fiercely competitive semiconductor business by strengthening its management and organization and diversifying its product lines. Dr. Harper Q. North, Pacific president, was named chairman of the board of the projected organization while Warren B. Hayes, previously general manager of TRW Components will be president.

▶ **Custom Miniaturized Circuits**—Miniaturized avionic circuits, fabricated to customer specifications, will be offered by the newly organized Signetics Corp., Sunnyvale, Calif. Company President Dr. B. David James and three vice presidents were previously with Fairchild Semiconductor Corp. Signetics will work closely with IMM Industries of North Hollywood, which holds an interest in the new firm. Signetics will be located at 680 West Maud Av., Sunnyvale.

▶ **Single-Crystal Gallium Arsenide Film Deposition**—Lear's solid-state physics laboratory has successfully evaporated single-crystal gallium arsenide films on calcium fluoride as a further step in its thin film semiconductor program (AW Dec. 5, 1960, p. 99; July 31, p. 62). The group previously reported progress with reproducible evaporation of germanium and silicon film on foreign substrates and the fabrication of elementary thin film devices from these films.

▶ **X-15 Pilot Bio-instrumentation**—Signal conditioning unit which weighs half a pound and attaches to a pilot's body and can accept and transmit up to 12 inputs from physiological sensors, was displayed recently at the American Rocket Society meeting in New York. Device can transmit physiological data from within pilot's pressure suit to remote receiver in aircraft's cabin without going through umbilical cord. The unit, built by Hughes Aircraft Co. for an accelerated Edwards AFB program to monitor North American X-15 pilot's physiological reactions (AW Dec. 26 p. 71) in flight, measures 8 in. x $3\frac{1}{2}$ in. x $\frac{1}{2}$ in.

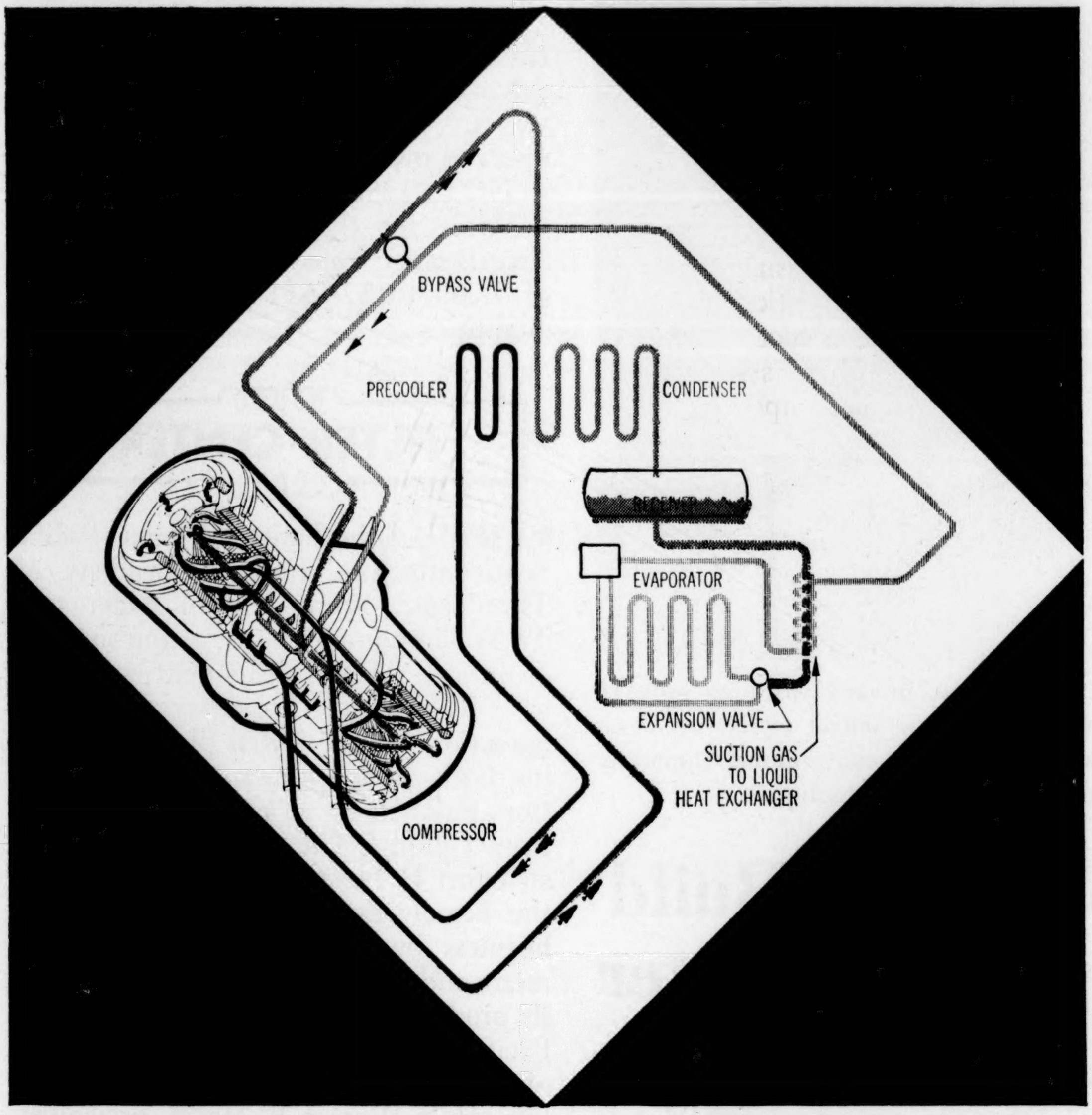
▶ **Millimeter Wave Masers**—Basic research on techniques and inherent limitations of masers operating in the millimeter wave region is being conducted by Hughes Aircraft Co. research laboratories under a one-year contract from the Army Signal Corps. Company is examining a variety of solids, such as emeralds and rutile, for possible use as active millimeter wave maser materials.

▶ **Optical Maser Improving**—Steady research with optical masers has resulted in devices capable of producing extremely high peak powers, although for only short durations, making the device look more attractive for ranging and detection (radar) applications. Energy outputs, while still small, are increasing by orders of magnitude over those of first devices operated a year ago.

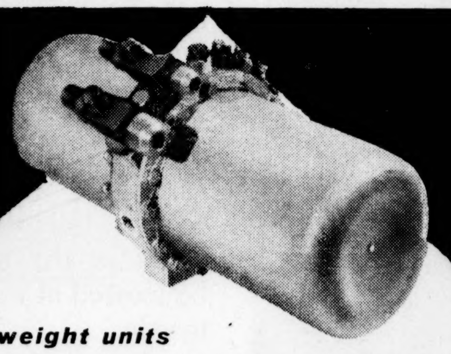
▶ **Photoelastic Delay Line Study**—Corning Glass Works will develop a photoelastic delay line with 1,000 taps, a delay time of 100 microseconds, a 10 mc. bandwidth, a signal-to-noise ratio of 40 db. at a center frequency of 30 mc. under Rome Air Development Division sponsorship. The photoelastic principle involves the use of optical sensors to detect an acoustic signal in a solid transparent dielectric material. The program will include investigation of the use of optical glass fibers for transmitting light impulses to the output photomultipliers.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

- **Thompson Ramo Wooldridge,** RW Division, Los Angeles, \$2-million contract for four AN/UYK-1 stored-logic computers to be used with Navy Transit navigation satellite, from Johns Hopkins University.
- **Collins Radio Co.,** Cedar Rapids, Iowa, three Navy contracts totaling \$190,559 for airborne navigation equipment, modification of existing equipment and engineering support for shipboard equipment.
- **Motorola, Inc.,** Chicago, \$6.3 million in two contracts from Navy for manufacture of sonobuoys.
- **Ampex Corp.,** Redwood City, Calif., \$2 million from Electro-Mechanical Research, Inc., for magnetic memory systems for flight testing Dyna-Soar vehicles.



NEW TASKLINE
REFRIGERATION COMPRESSORS



lightweight units
feature low speed, long life, high reliability

Six new models ranging from $\frac{1}{4}$ H.P. to 4 H.P.* make up this new line of lightweight, accessible hermetic compressors developed for missile, aircraft and air transportable applications. All units operate at approximately 3,600 RPM with either 3 phase, 400 or 60 cps motors. Fresh design approach has resulted in small envelope size and light weight. ◆ Pumping units feature a rotary type compressor with reduced sensitivity to contamination. Unique centrifugal separator returns refrigerant entrained oil to the compressor sump. Improved cycle efficiencies result from isolating the compressor within the hermetic housing and circulating the pump discharge gas thru a precooling circuit to cool the motor. All units are manufactured to rigid military specifications. ◆ For further information phone **PRospect 4-3100** or write:

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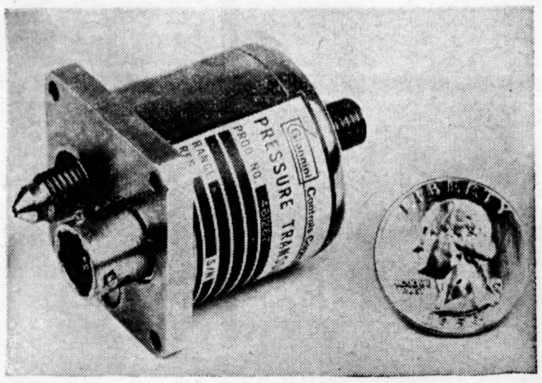
Calif.

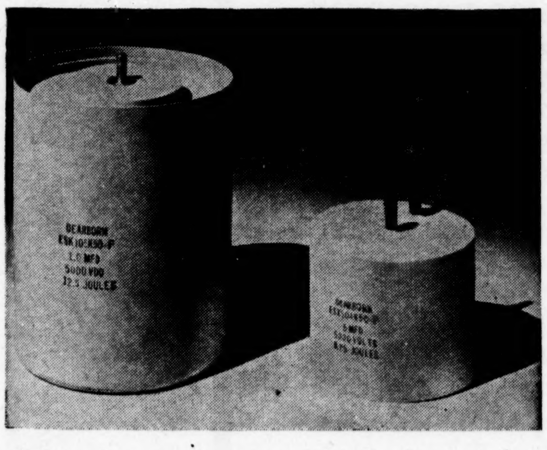
NEW AVIONIC PRODUCTS

• **Pressure transducer** provides high-pressure measurements in 50g environment and is suited for use in ground support systems, engine pressure measurements and hydraulic system telemetering. Transducer weighs less than ½ lb., has ranges from 0 to 100 psi. and 0 to 8,000 psi. Resolution is 0.25%, repeatability of 0.5%. Manufacturer: Giannini Controls Corp., 1600 S. Mountain Ave., Duarte, Calif.



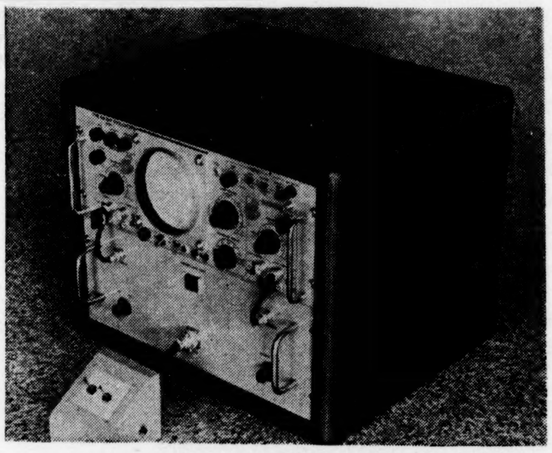
• **X-band lens antenna,** model ALXN-1A, radiates circular polarization with hemispherical radiation coverage. Two lens antennas on airborne vehicle can provide complete tracking coverage for any yaw, pitch or roll aspect. Ellipticity ratio is better than plus or minus 1.5 db. over a hemisphere; signal is constant within about plus or minus 2.4 db. over the hemispherical coverage. Manufacturer: Canoga Electronics Corp., P.O. Box 550, Van Nuys, Calif.

• **High-energy storage capacitors,** which can be made to discharge in 0.1 microsec., have minimum self-inductance and insignificant series resistance. Other features include low contact resistance at electrode terminations, high ringing frequency, and high Joules per cubic in. per lb. Manufacturer: Dearborn Electronic Laboratories, Inc., P.O. Box 3431, Orlando, Fla.

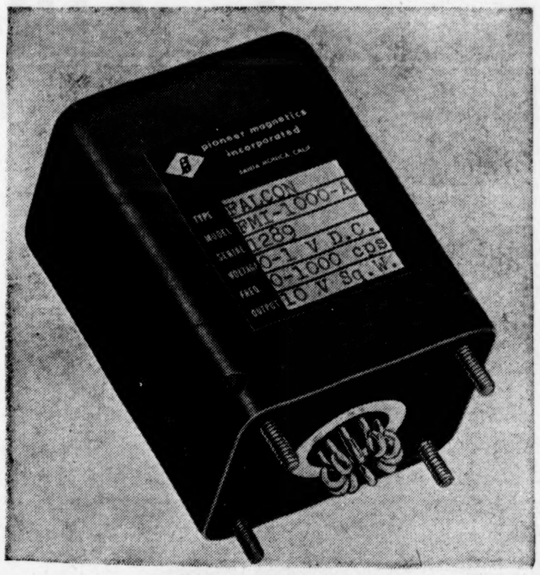


• **Micro rectifiers,** a variety of 15 high-voltage micro rectifiers and 17 full wave bridge rectifiers, in micro packages is being offered. Typical of these devices are high-voltage rectifier types PS2501 through PS2515, covering peak inverse voltage range from 2,000 to 25,000 volts. Each package is 250 mils wide, 150 mils thick. Maximum lengths are 650 mils, 1.20 in., 1.75 in. and 2.5 in. depending on voltage range. Rectifiers with axial or radial leads can be supplied. Manufacturer: Pacific Semiconductors, Inc., 12955 Chadron Ave., Hawthorne, Calif.

• **Diode tester,** provides visual monitoring of reverse characteristics of semiconductor diodes. Test factors include breakdown voltage, noise, stability, reverse leakage and zener impedance. Accuracy is within ± 5% with negligible drift after warmup. Tester is priced at $1,425 with 30 to 60 day delivery. Manufacturer: Micromodular Division of Ling-Temco Electronics, Inc., P. O. Box S-1, Anaheim, Calif.



• **Voltage-to-frequency converter** will convert zero to five volts d.c. or greater potentials into pulse or square wave output, whose frequency varies linearly with the d.c. input signal from nearly 0 cps. to preset full scale frequency. Full scale output frequencies of four standard models range from 500 cps. to 4,000 cps. Manufacturer: Pioneer Magnetics, Inc., 850 Pico Blvd., Santa Monica, Calif.



• **Analog digital converter,** Model M3 multiverter provides illuminated display of three decimal digits plus a sign with an accuracy of conversion to within 0.05% ±½ least significant bit. Manufacturer: Packard Bell Computer, 1905 Armacost Ave., Los Angeles 25, Calif.

PROBLEMATICAL RECREATIONS 90

What is the largest number which can be obtained as the product of positive integers which add up to 100? *—Contributed*

Digital Engineers, if you couldn't contact us at the East Coast Conference on Aeronautical and Navigational Electronics last week, why not contact our Mr. Harry Laur direct about career possibilities in our Data Systems Division. The work involves applying advanced techniques to the design and development of airborne and ground-based data handling and display systems. The place is Canoga Park, California.

ANSWER TO LAST WEEK'S PROBLEM: One round trip. At the basement, short circuit pairs of wires, leaving one odd wire. At the roof the odd wire is found and labeled 1. It is then shorted to any wire which is then labeled 2. The wire to which 2 was shorted at the basement is found and labeled 3. Wire 3 is shorted to any remaining wire which is labeled 4. Wire 5 is found as the wire to which 4 was shorted in the basement, etc. Then, at the basement, the original short circuits are opened. Wire 1 is the odd wire. Wire 2 is found by finding the wire shorted to 1. Wire 3 had been originally shorted to 2 in the basement. Wire 4 is found by finding the wire shorted to 3, etc.

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Openings in the fields of: **Aircraft Design Engineering • Engineering Drawings Checking • Aircraft Structures • Basic Loads • Flutter and Vibration • Sound and Vibration • Aircraft Specifications Engineering • Reliability Engineering • Operations Research • Aircraft Research Engineering • Technical Writing • Aircraft Castings and Forgings • Aircraft Hydraulics and Controls Systems Analysis.**

Write to: **Hugh L. Gordon, Professional Employment Manager, Lockheed-Georgia Co., 834 W. Peachtree St., Atlanta 8, Georgia. Department DD-75.**

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A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

CAB Accident Investigation Report:

Landing Maneuver Cited in TWA Crash

On November 24, 1959 at approximately 0535 CST, a Lockheed Constellation, N 102R, Flight 595, operated by Trans World Airlines, Inc., crashed into a residential area about one-fourth of a mile southeast of Midway Airport, Chicago, Illinois, killing all persons aboard, demolishing the aircraft, and fatally injuring eight persons on the ground.

Flight 595, loaded with cargo, took off on runway 31L of Midway at approximately 0531 CST, November 24, 1959, bound for Los Angeles, California. As the aircraft began a left turn, the crew notified Midway Tower they had received a fire warning on the No. 2 engine and had shut it down. They also informed the tower the flight would return and land. The aircraft proceeded in a continuing left turn around the airport in an elliptical pattern and below the clouds which were based at an altitude of 500 to 600 feet.

In the turn to final approach to runway 31 the aircraft banked in excess of 45 degrees during which it developed an excessive rate of sink. When the aircraft reached the tops of the trees its wings were nearly level and its nose was raised in a climbing attitude; however, the descent continued. The wing flaps were being retracted during the last 5 to 10 seconds of the final descent and were found to be symmetrically extended at 24 per cent upon impact.

It is the conclusion of the Board that this accident was the consequence of maneuvering the aircraft during the turn to final approach in such a manner as to cause a rate of sink from which recovery was not possible.

Investigation

Trans World Airlines Flight 595 of November 24, 1959, was a scheduled cargo flight from Midway Airport, Chicago, Illinois, to Los Angeles, California, and the aircraft assigned was a Constellation, model L1049H, serial number 1252, N 102R. The crew consisted of Captain Claude Wilbert Helwig, First Officer Delmas Earl Watters, and Flight Engineer Aerion Lyman Auge, Jr.

Flight 595 was scheduled to depart Midway Airport at 0310[1] November 24, 1959; however, departure was delayed by the inability of the ground crew to complete loading of the aircraft because of a breakdown in loading equipment. As a result it did not depart until about 0530. Evidence indicated that at departure the aircraft was properly loaded to a gross weight of 126,606 pounds. The allowable gross weight for takeoff computed for this flight was 127,400 pounds, and the allowable landing weight was about 115,000 pounds.

The aircraft had been flown from New York City to Midway where it landed at 0216 November 24. The flight was reported by the incoming crew as routine. The incoming engineer did, however, make a log entry specifying that the ignition analyzer indicated that a spark plug on each of engines Nos. 1, 2, and 4 had developed the initial stage of secondary high resistance. All maintenance persons contacted, including the incoming engineer, stated the condition did not require a change of the affected plugs, and in their opinion the aircraft was completely airworthy for the flight to Los Angeles.

The crew assigned to Flight 595 was off duty from November 20, 1959, until the morning of November 24. Rather than spend their layover in Chicago each of the three crew members returned to his home in California via TWA in a passenger capacity. Captain Helwig returned to Midway at 1645, November 23, and checked into the crew lounge at TWA's operations at 2140 and then retired. First Officer Watters arrived at Midway at 0720, November 23, and checked into a hotel. Flight Engineer Auge returned to Chicago's O'Hare Airport at 2115 on November 23 and checked into the crew lounge at Midway at 2345. At 0050 on the morning of the 24th First Officer Watters was alerted for the flight, and then at 0200 that same morning Captain Helwig and Flight Engineer Auge were alerted.

The flight was dispatched in accordance with TWA's procedures and the crew filed an IFR flight plan to Los Angeles. The aircraft was inspected by the crew and about 0520 it was taxied to runway 31L for takeoff. The flight was then about 2 hours and 20 minutes behind schedule. The flight received its ATC clearance to the Los Angeles Airport and its takeoff time was logged by Midway Tower as 0531.

Conversation Recorded

The conversation between Flight 595 and Midway Tower was tape recorded. The flight started its takeoff roll upon or immediately after acknowledging Midway Tower's takeoff clearance. The timing of the events that followed started the instant Flight 595 acknowledged its tower clearance to commence the takeoff roll.

The takeoff appeared normal to the tower operators. After 1 minute and 13 seconds the crew transmitted they were starting a left turn. Seven seconds later the crew informed the tower of the fire bell on the No. 2 engine, that the engine had been shut down and the flight was coming back in. During the next 25 seconds Midway Tower gave landing clearance to the flight for runway 31 or any runway it desired to use. The crew told the tower they would use runway 31. Eleven seconds later the flight rejected an offer from the tower to call out the emergency equipment.

Midawy Tower asked Flight 595 if it desired a Kedzie localizer approach[2] or if the crew wanted to make it VFR. To this question they answered, "I think we'll make it VFR OK." Forty-five seconds had elapsed since their last transmission. Six seconds later, Flight 595 acknowledged its clearance to land on runway 31L with an "OK." Total elapsed time since takeoff was then 2 minutes and 47 seconds. Forty-three seconds later the tower operator transmitted, "NO . . . . NO!!" which he explained was a spontaneous exclamation upon seeing Flight 595 crash into the houses and burst into flames. A total time of 3 minutes and 30 seconds had then elapsed. The exact time of the crash was fixed at 0535 as that was the time the Commonwealth Edison Company of Chicago recorded the power failure resulting when Flight 595 hit their powerlines.

Prior to Crash

Ten minutes prior to the crash the United States Weather Bureau reported the Midway weather as follows: Partial obscuration, scattered clouds at 600 feet, measured 900 foot overcast; visibility 3 miles; light rain, fog, and smoke; wind west 10 knots; temperature 39; dewpoint 38', and altimeter setting 29.33; Remarks: 2/10 of sky obscured by fog. The crew of an aircraft which took off about three minutes prior to 595's takeoff reported to Midway Tower about one minute before the accident that there were scud clouds west of the airport at 500 feet. Twenty minutes after the accident the overcast was reported at 600 feet and the visibility still 3 miles. This latter observation was a routine Weather Bureau observation at 0555. The Weather Bureau did not make a special accident observation because they were not notified of the accident until 0605.

According to witnesses there was no ice being formed on any of the buildings or aircraft on the ground from the light rain that was falling at the time of the accident.

The total distance Flight 595 traveled over the ground from the beginning of its takeoff roll to the point of impact was about eight statute miles. This flightpath was elliptical in shape and at no time was the aircraft more than two miles from the airport. Ground observers all stated that their view of the aircraft was never obstructed by clouds.

According to witnesses, including tower personnel, the aircraft banked in excess of 45

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[1] All times herein are Central Standard based on the 24-hour clock.

[2] Kedzie is a low frequency compass locator radio beacon at the outer marker of the ILS approach to runway 31L at Midway, 3.3 nautical miles on an extended centerline from the approach end of runway 31L. To fly this approach an aircraft should be on the heading of that runway at 1,500 feet m.s.l. (about 900 feet above the ground) and prepared to start a descent to that runway as it passes over the beacon.

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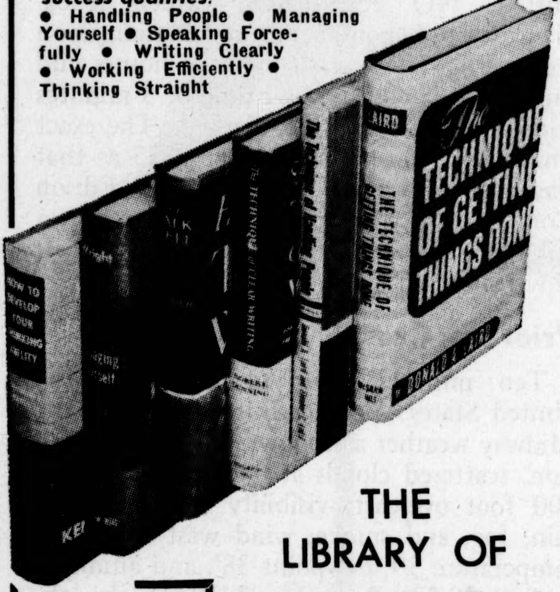

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degrees during the left turn to the final approach heading. It lost altitude as the turn progressed and when it reached an altitude described as just above the tops of the trees the wings were almost level and the nose was raised slightly to a climbing attitude; however, the rate of descent continued until the aircraft struck the trees and buildings. Statements of witnesses along the flightpath and within one mile of the impact area indicated that the engines sounded as if they were laboring to keep the aircraft airborne.

Investigation of the wreckage indicated that the left main and nose gear assemblies were up but unlocked and the right main gear was up and locked. The wing flaps were extended symmetrically about 13 inches or 24 per cent of their full travel, and the wing flap control valve and follow-up mechanism were positioned for flap movement toward the "up" position.

The wing flap control lever was about one-eighth of an inch aft of the full forward position and bent over 80 degrees toward the captain's seat. It was jammed in that position as a result of the impact and appeared to have been in that position prior to impact as there was no indication of the lever having been forcibly moved to or from the jammed position. The wing flap control lever, is located on the top, right side of the center control stand. There are four placarded positions on the quadrant: "Take-off" (60 per cent extension), "Approach" (66 per cent extension), "80 per cent" (80 per cent extension), and "Landing" (100 per cent extension). There are lever-position detents at the above-mentioned settings except the "Approach" position. There is also a detent at the full forward (fully retracted) position. The wing flap control lever will remain in any selected position until moved whether in the detent or not. The wing flap control unit allows pre-positioning of the flaps and changing direction of the flap movement at any time without completing the selected cycle. Retraction time for the wing flaps from a setting of 60 per cent to fully retracted is about 15 seconds provided the landing gear is not retracted at the same time.

Engine Shutdown

Examination further revealed the No. 2 engine had been shut down and its propeller feathered. There was no evidence of any inflight fire; however, the fire extinguisher had been activated in the No. 2 engine. The ground fire and impact damage precluded any testing of the fire warning system serving the No. 2 engine. Engines Nos. 1, 3, and 4 appeared to be in good condition aside from impact damage. There was no evidence of structural failure prior to impact or any indication that the cargo may have shifted. Upon impact, a jet engine weighing 5,880 pounds was torn directly from its tie-down position in the cargo compartment and thrown clear of the wreckage.

On January 23, 1960, a test flight in the same type aircraft was conducted by the Lockheed Aircraft Corporation at Los Angeles, California. Conditions surrounding the fatal flight were simulated as nearly as possible. Definite stall warnings were apparent to the pilot in all of the test runs and recoveries from the stall buffet zone could be made with a loss of no more than 200 feet of altitude. On one of the runs the aircraft was banked up to 42 degrees and the airspeed allowed to drop to 108 knots indicated. A fairly rapid rate of sink developed and the aircraft was not yet in the stall buffet zone. Not enough power was available to keep the aircraft in level flight and a loss of several hundred feet was necessary to acquire enough airspeed to recover from this sinking condition. The pilot described the aircraft as being on the backside of the power curve.

On this flight the wing flaps were retracted from 60 per cent to 0 per cent and from 80 per cent to 0 percent. Simultaneously with these flap retractions the landing gear was retracted from the "down and locked" to the "up and locked" position. The retraction times respectively were as follows: flaps: 21 seconds; gear: 19 seconds; flaps: 24 seconds; gear: 15 seconds.

Analysis and Conclusions

The flight had progressed from New York to Chicago in a normal manner. Ground handling of the aircraft at Midway Airport was properly conducted but difficulty with equipment caused a delay in loading of the aircraft cargo compartment which, in turn, caused the flight to be behind schedule. All documents and records pertaining to the status of the aircraft were in order and indicated the aircraft was airworthy and properly loaded.

The crew's training and proficiency records indicate the crew members were properly qualified for the flight as planned. The company provided ample opportunity for them to obtain sufficient rest prior to their flight; however, it appears questionable that the captain and flight engineer took full advantage of this opportunity.

The aircraft was operating in a satisfactory manner until the fire warning shortly after takeoff. The captain had successfully coped with the emergency, and engines Nos. 1, 3, and 4 were in good operating condition and capable of sustaining the aircraft in properly conducted flight.

The control tower operators offered their assistance to the flight by giving them clearance to land on any of the runways and offering to have the emergency equipment and crew stand by. The flight's rejection of the offer to alert the emergency crews indicates they were not extremely concerned for their safety and had the situation pretty well in hand. It further suggests that the crew was certain there was no actual fire in the No. 2 engine.

For the flight to have made a Kedzie localizer approach would have necessitated their climbing to an altitude which would have put them in the overcast and consumed considerably more time. Their decision to stay VFR below the clouds was reasonable; however, this did make it necessary for them to fly at an altitude between 400 and 600 feet above the ground.

Analysis of weather conditions existing at the time of the accident showed that Flight 595 should not have encountered structural icing or significant turbulence during its short flight.

In anticipation of landing, a gear-down, flap-extended configuration was established on the downwind portion of the traffic pattern. The wing flaps were at least in the takeoff position of 60 per cent and had been allowed, presumably, to remain so extended since takoff, because less than one minute had elapsed from start of takeoff roll until the fire warning, and at that time the captain planned to return to land. The track over the ground on the "downwind" curved toward the runway. When the aircraft was positioned to start the turn to final approach a sharp turn was needed to avoid overshooting the extended centerline of runway 31L.

The Board believes the captain attempted such a turn, and in doing so combined a very steep bank with high gross weight and three-engine aircraft configuration in such a manner that the aircraft entered a regime of flight describable as being on the backside of the power curve. More power and altitude than was available to him was needed to safely recover the aircraft. At some point in this turn the captain very probably decided to discontinue the landing approach and attempted a "go-around." Hence, he called for gear up at or near this same point, but for an unexplained reason the wing flap controls were positioned for flap retraction.

The Board believes an accident such as this is a certainty when at low altitude an excessive rate of sink is coupled with the additional loss of lift caused by the simultaneous retraction of the wing flaps from 60 to 24 per cent. The flap setting of 24 per cent was their intransit position as the aircraft struck the ground.

Probable Cause

The Board determines the probable cause of this accident to be the maneuvering of the aircraft in a manner that caused it to develop an excessive rate of sink while in the turn to final approach.

By the Civil Aeronautics Board:

ALAN S. BOYD
Chairman
ROBERT T. MURPHY
Vice Chairman
G. JOSEPH MINETTI
Member
WHITNEY GILLILLAND
Member

Chan Gurney, Member, did not take part in the adoption of this report.

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at 0605 November 24, 1959. An investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and held in the Shoreland Hotel, Chicago, Illinois, on January 5 and 6, 1960.

Flight Personnel

Captain Claude Wilbert Helwig, age 40, was employed by Trans World Airlines on September 24, 1945, as a student first officer. On December 2, 1945, he was promoted to first officer and on September 24, 1954, promoted to captain. He held a valid FAA airline transport pilot certificate with rating in the Martin 202/404, Lockheed Constellation, and Douglas DC-4 aircraft. He held a single and multi-engine land rating and commercial privileges. Captain Helwig had a total of 12,467 hours, and 1,670 in the Constellation. His latest Class I physical examination was completed on June 18, 1959. His last proficiency checkout was in a Constellation 049 on October 16, 1959, and his last line check was in the same type aircraft on December 17, 1958. The date of his last review of emergency equipment was June 24, 1959. Captain Helwig had been checked out in the 1049G model of the Constellation since July 3, 1956.

First Officer Delmas Earl Watters, age 36, was employed by Trans World Airlines as a student first officer on October 27, 1952; he was promoted to first officer on January 19, 1953; and on December 31, 1958, was promoted to reserve captain. He held a valid airline transport pilot certificate with ratings in the Lockheed Constellation aircraft and had commercial, single-engine land and sea, and multi-engine sea privileges. Mr. Watters had a total of 6,285 hours of flying, of which 3,919 hours were in the Constellation equipment. His last proficiency check was accomplished on October 9, 1959, in a flight simulator, model 1649A. His last line check was accomplished on a Constellation, model 049, on May 25, 1959. Mr. Watters' last Class I physical examination was completed on May 18, 1959. The date of his last emergency equipment review was October 9, 1959, and he had been checked out in the 1049G model of the Constellation since August 18, 1955.

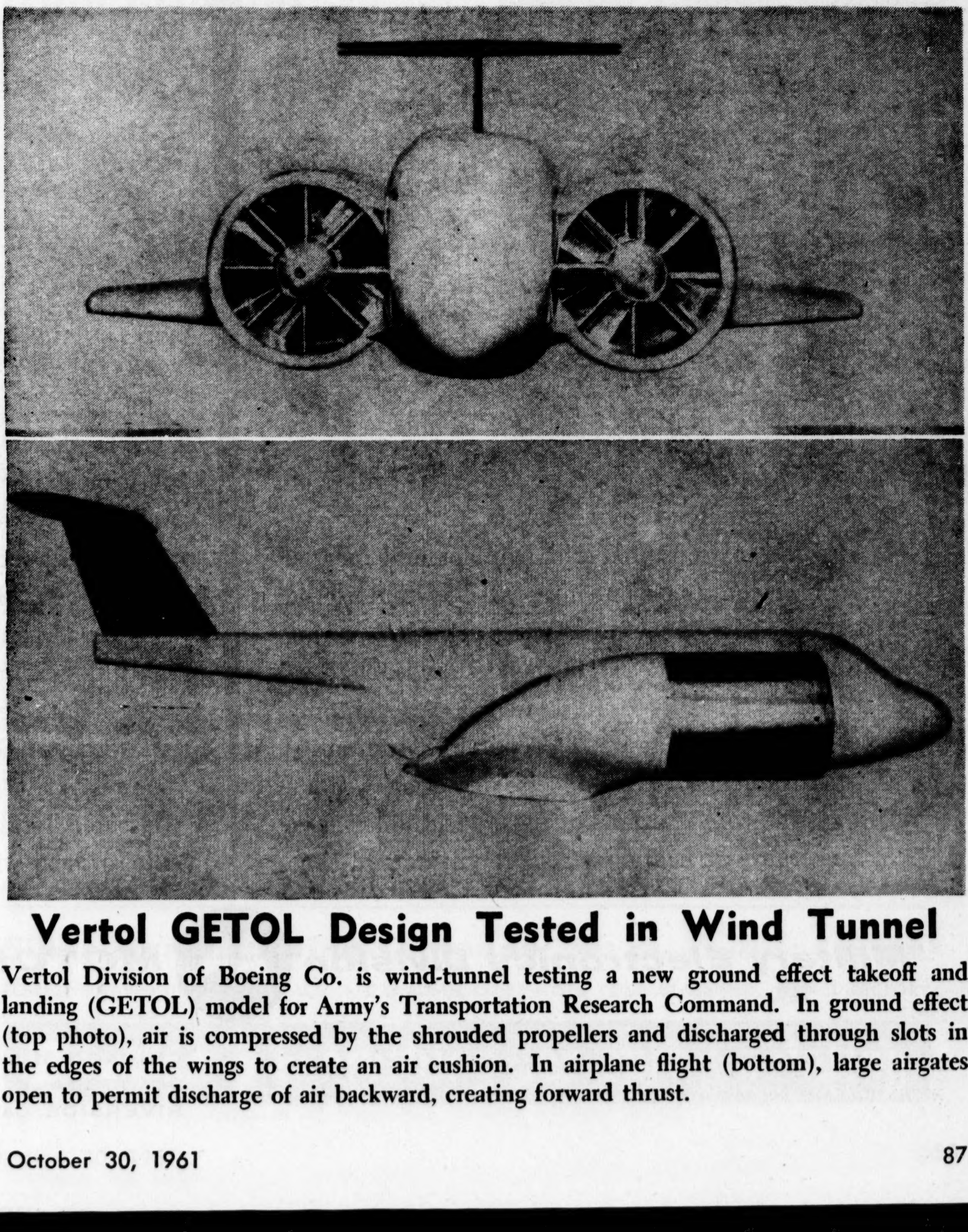
Flight Engineer Aerion Lyman Auge, Jr., age 35, was first employed by Trans World Airlines as a student flight engineer on May 4, 1953, and was checked out as flight engineer on September 10, 1953. He held a valid airframe and powerplant rating of an aircraft mechanic certificate; a flight engineer certificate; a pilot certificate; and airframe and powerplant ground instructor certificate. He had 5,100 hours flying time in the Constellation as flight engineer. His last proficiency check was given on July 10, 1959; his last checkout in the 1049G model of the Constellation was on June 14, 1955; and the date of his last review of emergency equipment was May 22, 1959.

The Carrier

Trans World Airlines, Inc., is a Delaware corporation with principal offices in Kansas City, Missouri. This corporation holds a current certificate of public convenience and necessity for scheduled and nonscheduled operations, and possesses valid air carrier operating certificates for these operations.

The Aircraft

N 102R was a Lockheed Constellation, model L-1049H, manufacturer's number 1252, and bore a manufacturer's date of June 6, 1957. The last base overhaul was accomplished on March 8, 1959, when it had a total time of 3,432:08 hours. It was powered by four Curtiss-Wright 988 turbo compound 18EA-3 engines, with Hamilton Standard propellers, model 43-H60-331. All of the blades were model 6959A-0. Engine No. 1 had 1,298:57 hours and its propeller had 194:31 hours since last overhaul. Engine No. 2 had 545:19 hours and propeller No. 2 had 1,594:45 hours since last overhaul. Engine No. 3 had 153:13 hours and its propeller had 1,429:35 hours since last overhaul. Engine No. 4 had 476:13 hours and propeller No. 4 had 2:55 hours since last overhaul.



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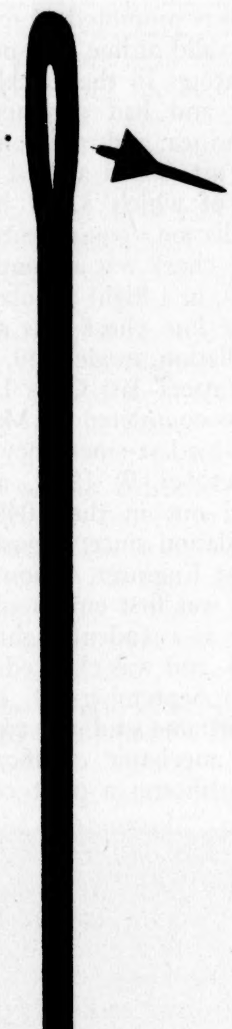
Vertol Division of Boeing Co. is wind-tunnel testing a new ground effect takeoff and landing (GETOL) model for Army's Transportation Research Command. In ground effect (top photo), air is compressed by the shrouded propellers and discharged through slots in the edges of the wings to create an air cushion. In airplane flight (bottom), large airgates open to permit discharge of air backward, creating forward thrust.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PRODUCTION BRIEFING

General Dynamics/Convair has received an $88,000 Navy contract to design and produce matting panels for portable landing strips for Marine jet fighter planes. Work on the SATS (small airfield for tactical support) landing matting will extend over 20 months, with research and development scheduled through January, 1962.

Lockheed Aircraft Corp.'s Missiles & Space Co. will study "interplanetary transportation systems" and spacecraft orbits under a $65,000 contract from National Aeronautics and Space Administration's Marshall Space Flight Center. The studies in Lockheed's scientific laboratories at Palo Alto, Calif., will include data on times, speed, directions and dates for interplanetary missions.

Douglas Aircraft Co. will produce additional hardware for the Nike Hercules anti-aircraft missile under a $1.75-million Army contract.

Polytechnic Institute of Brooklyn, N. Y., will study longitudinal and tangential modes of instability in liquid propellant rocket engines under a $91,565 grant from the Air Force.

Pratt & Whitney Aircraft division of United Aircraft Corp. has successfully pressure-tested a high-strength steel rocket motor case with demonstrated measured stresses up to 311,000 psi. The case, made of forged vacuum-remelted H-11 steel, was tested under a development program for Navy's BuWeps.

Raytheon Co. Lexington, Mass., has received contracts totaling almost $9.5 million from the Boston Ordnance District for engineering and technical services on the Army's Hawk missile.

Underseas Cable Corp. has won a $5-million Air Force contract to extend the Atlantic Missile Range underwater cable 700 mi. from Grand Turk to Puerto Rico.

Ford Motor Co.'s Aeronutronic Division has received an $8-million contract to continue development of the Army's Shillelagh surface-to-surface missile for close-in troop support.

Evaluation of the RP-76 target made by Northrop Corp.'s Radioplane Division for use with air-to-air and surface-to-air missile systems has been completed for the U. S. Navy. The targets were tested while flying at altitudes of 40,000 ft. and speeds exceeding Mach 0.9 over the Pacific Ocean about 50 mi. from Pt. Mugu.

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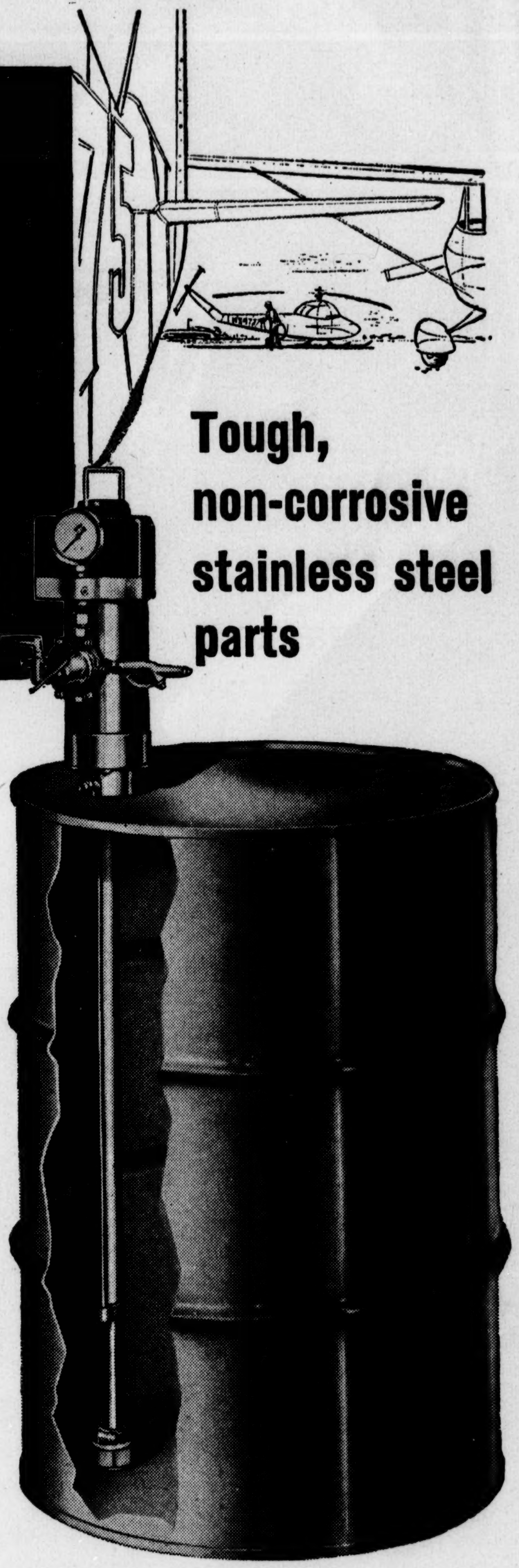

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FINANCIAL

New Offerings

Stockholders of Laboratory for Electronics, Inc., and Tracerlab, Inc., will vote on a proposed merger of Tracerlab into LFE at separate meetings Sept. 19. Record date for stockholders eligible to vote was Aug. 11. On that date, Tracerlab had 725,788 shares of common stock outstanding and LFE had 1,136,636 common shares outstanding. Under the proposed merger, each 4½ shares of Tracerlab common will be converted into one share of LFE common. Proposal also calls for Tracerlab to retain its name and continue operation in its present locations as a group of LFE divisions and subsidiaries. Tracerlab produces scientific and industrial instruments and equipment for utilization detection and measurement of radioactivity, processes radioisotopes and carries on research and service activities in nuclear physics and chemistry. LFE produces airborne navigation and radar systems, microwave test instruments and data storage and display equipment. Tracerlab's principal offices, laboratories and manufacturing facilities are located at its branch in Waltham, Mass. LFE headquarters are in Boston.

Orbit Instrument Corp., Syosset, N. Y., engaged in the development and production of miniature precision electromechanical components. Offering is 100,000 capital shares at $4 per share. Proceeds will be used for new and expanded engineering, testing and laboratory facilities; new product development and production and sales promotion; expansion of business in Italy; retirement of indebtedness.

FMC Corp., San Jose, Calif., engaged in the manufacture of diversified products including missile ground handling equipment and air transportable vehicles. Offering is $30,000,000 of convertible subordinated debentures, due 1981. Proceeds will be used for payment of 2½% sinking fund debentures, due 1962; modernization and expansion of facilities; additional investment in new and existing lines of machinery for leasing in the U. S. and abroad.

Nuclear Corporation of America, Phoenix, Ariz., manufacturer of radiation monitoring instruments, material and density gages, and radiation systems for the government, and high power and special purpose vacuum tubes, and semiconductor devices. Offering is 536,280 capital shares by United Industrial Corp., and $2,087,800 of 5½% convertible subordinated debentures, due 1976, for subscription by capital stockholders at the rate of $100 of debentures for each 300 shares held. Proceeds from the debenture sale will be used in part to retire bank loans of $600,000; a $357,520 note payable to the selling stockholders; a $229,166.67 note payable by U. S. Semiconductor Products, Inc. (a subsidiary recently acquired from United Industrial) to United Industrial. The company has outstanding 6,263,518 capital shares, of which the Martin Co. owns 21.4%.

Financial Briefs

Aerojet-General consolidated sales for the nine months ended Aug. 31 totaled $348,458,624 and earnings for the same period were $8,835,148. This compares with nine-month 1960 consolidated sales of $308,375,504 and earnings of $6,757,803.

Collins Radio Co. has reported earnings of $3,075,000, or $1.39 per share, including a special credit of 0.24 cents per share, for Fiscal 1961. Sales of $215 million for the year, ended July 31, are noted by the firm, which adds that this represents a 13% increase over the previous year and a new high in its history. Reduced earnings are attributed to cost of new product development and heavy pre-production and are also attributed to start-up costs on new products.

Airtek Dynamics, Inc., of Compton, Calif., reported net income of $58,719 on sales of $2,092,432 during first of half of 1961, equal to 16 cents per share on 373,947 common shares outstanding. During the same period last year, sales were $1,220,455 and the company sustained a net loss of $149,473. Company is producing precision-machined components, pressure vessels and tankage for missile and satellite programs and has completed first phase of research and development of new design criteria for solid rocket motor cases.

Directors of Aeroquip Corp. of Jackson, Mich., voted a 2% extra dividend equivalent to 61 cents, payable Sept. 30 to stockholders of record Sept. 5. Cash payments will be made in lieu of fractional shares. Extra dividend of 4% was paid on common stock for Fiscal 1960.

Atlantic Research Corp. of Alexandria, Va., reported new highs in sales of $9,039,071 and earnings of $606,036 for first half of 1961. Per share earnings for January-June 1961 were 34 cents as opposed to 21 cents per share for the same 1960 period.

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LETTERS

Engineer Lag

God bless Admiral Hayward and Robert Hotz! We figured a while back, conservatively, that the U.S. is spotting the USSR 15,000 engineers every year in this "bitter battle of baloney."

J. R. Tracey, Head
Technical Publications Group
Hughes Aircraft Co.
Fullerton, Calif.

As a preliminary design engineer intimately concerned with bringing new business to my company I must take strong exception to some of your remarks in the Oct. 9 issue. To suggest that the recent VTOL Tri-Service competition was limited to brochuremanship shows your lack of understanding of the facts.

Without going into the detail, our proposal represented a monumental effort of analytical, wind tunnel, and design work by a truly dedicated team of our most experienced engineers. People worked tirelessly without a break from the time the specification arrived until the Monday after Easter Sunday at which time some 600 pounds of technical substantiation was dispatched simultaneously to NASA, the Navy, the Army and the Air Force.

There was not one claim in our proposal that was not backed by analysis, wind tunnel results, design study or actual mockup details. The IBM machines ran almost continually generating that information so desperately needed to "put money where our mouth was."

As far as an actual brochure goes, that's a requirement to let the busy high ranking officers get a quick look at what's going on without having to wade through reams of technical data.

No company can prepare a first class proposal without having done years of background research. It seems to me that the technical evaluators can tell who is exaggerating, and who is not. One of the real problems is that very often political considerations outweigh the technical decisions and an inferior design may be selected so that some company in a depressed area may continue to provide the residents with adequate employment.

In summary, I might say that it is too bad that you personally, could not have been permitted to see our proposal effort. Actually you probably wouldn't have understood the technical details and would have asked for a brochure (with pictures) to look at.

Donald B. Terrana
Oakdale, New York

Shorted Shortline

Under Shortlines column in the Oct. 9 issue of Aviation Week (p. 48), it would have been appreciated if you had mentioned that we were the contractors to the program for the actual operation of the DC-6A/B equipment. This covers both flight crews and maintenance technicians.

Grove Webster, Vice President
Purdue Aeronautics Corp.
Lafayette, Ind.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Ice Removal

The CAB Accident Investigation Report in two parts, (AW Sept. 11, p. 105, and Sept. 18, p. 93), determined that probable cause of the accident was the failure of the anti-icing and de-icing systems to prevent and remove carburetor ice under the atmospheric conditions encountered. I have this question, "Why didn't CAB take this opportunity to mention an emergency procedure for removing carburetor ice?"

There are an Air Force Tech Order and Army TM (2R-1-13-L) which give an emergency procedure for removing carburetor ice. The emergency portion of the Army TM is as follows:

"Under extreme icing conditions, the formation of ice may be so rapid and the loss of power so abrupt, that prompt use of carburetor air heater and alcohol anti-icing equipment is necessary to prevent total loss of power. If such severe ice formation is indicated, full heat will be applied and throttle will be opened wide. If this does not prove adequate (and it evidently did not in the case of N-37500), and it is impossible to generate sufficient heat to clear the induction system of the ice, the carburetor heat control will be placed in full cold position and the mixture will be leaned until backfiring occurs, which will loosen, break up, and melt, or blow clear the ice in the intake passages.

"Warning: This is a dangerous procedure and will not be used except as a last resort and then only with the carburetor heater in cold position (to avoid damage to heater valves).

"It is necessary to be prepared to immediately reduce throttle opening and richen the mixture when power is regained."

Could this last resort emergency procedure have saved N-37500? If the answer is yes, CAB should have pointed this procedure out to help prevent such accidents in the future.

I have known many pilots who did not know of this emergency procedure for removal of carburetor ice. I feel you would be doing a good deed to print this procedure for emergency only.

Also, the aircraft struck the ground inverted in a steep attitude. No mention of the importance of attitude control of aircraft under emergency conditions in weather. This can't be over emphasized.

The emergency ice removal procedure would be the only answer in the case of malfunction of the carburetor heat control (broken, jammed, etc.), especially in the case of single engine L-20 Beavers.

Donald A. Smith
Capt., Corps of Engineers
U. S. Army
Fort Belvoir, Va.

Pilot's Lament

I have been either a purchaser or subscriber to Aviation Week for over five years and I firmly believe that your publication sets the pace throughout the aviation industry for honesty, integrity and presenting both sides of a story, as well as an individual's point of view.

It is with the most sincerity that I bone up enough courage to tell you a few facts that I feel should be passed along to the young fliers throughout this great country, who are making many sacrifices today to become professional aviators tomorrow.

Three young men, a close friend, a relative and myself, began nine years ago to work toward the private license, flying in aircraft and grass fields compatible with this level of instruction. We wound up many years later having owned five aircraft, three of which we rebuilt from government surplus. We did the many, many requirements for private, commercial, SEL, MEL, instrument and A&E ratings, praying much of the time that the termites continue to hold hands for just a few more badly needed hours. It goes without saying that we spent many dollars; borrowed many more dollars and left our wives airport widows.

As a result of these years, the trio went to work in aviation; one with a feeder airline in the South, the second with a flying service, and the third gained a position with a major airline. However, first came a cutback, second a recession caused a discontinuance of the flight service, and third, financial problems concluded in a merger.

All three of us now find ourselves in other fields of employment, far from the cockpit of an airplane and, I must say, it turns my stomach to think of the sweat, money, some odd 8,000 total flight hours of experience and 21 man-years of experience that are now being wasted.

I have a 6½ year old son who already wants to be a pilot. And I ask you, how can I honestly direct or encourage interest in such a profession when throughout the industry the cruise speeds are forever being increased and crew utility is being crucified to a point where the professional pilot of today will probably be doing Mach 2 in the poor house tomorrow, that is if he lives through the airways systems that I remember were inadequate in many ways at 260-kt. airspeed.

It appears to me that the pilot of aircraft today would do much better to tie a fuse to his empennage and point himself at the moon, as this course seems to be the major interest of today. It both amazes and saddens me to think of how quickly the needle-ball and airspeed manipulators have been forgotten.

I hope you can find space to publish this account, because somebody should tell all these would-be airmen what they are up against, as I can remember well the shoes this boy of mine did without so I could "build time" for that magnificent commercial pilot level. So I say in all sincerity: Who's kidding who about a pilot's future in aviation?

John C. Noone
Palmyra, N. J.